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Waterways Experiment Station

Chipola Cutoff Reach, Apalachicola River Movable-Bed Model Study

by Randy A. McCollum

WES

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Prepared for U.S. Army Engineer District, Mobile

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Final report

Prepared for U.S. Army Engineer District, Mobile
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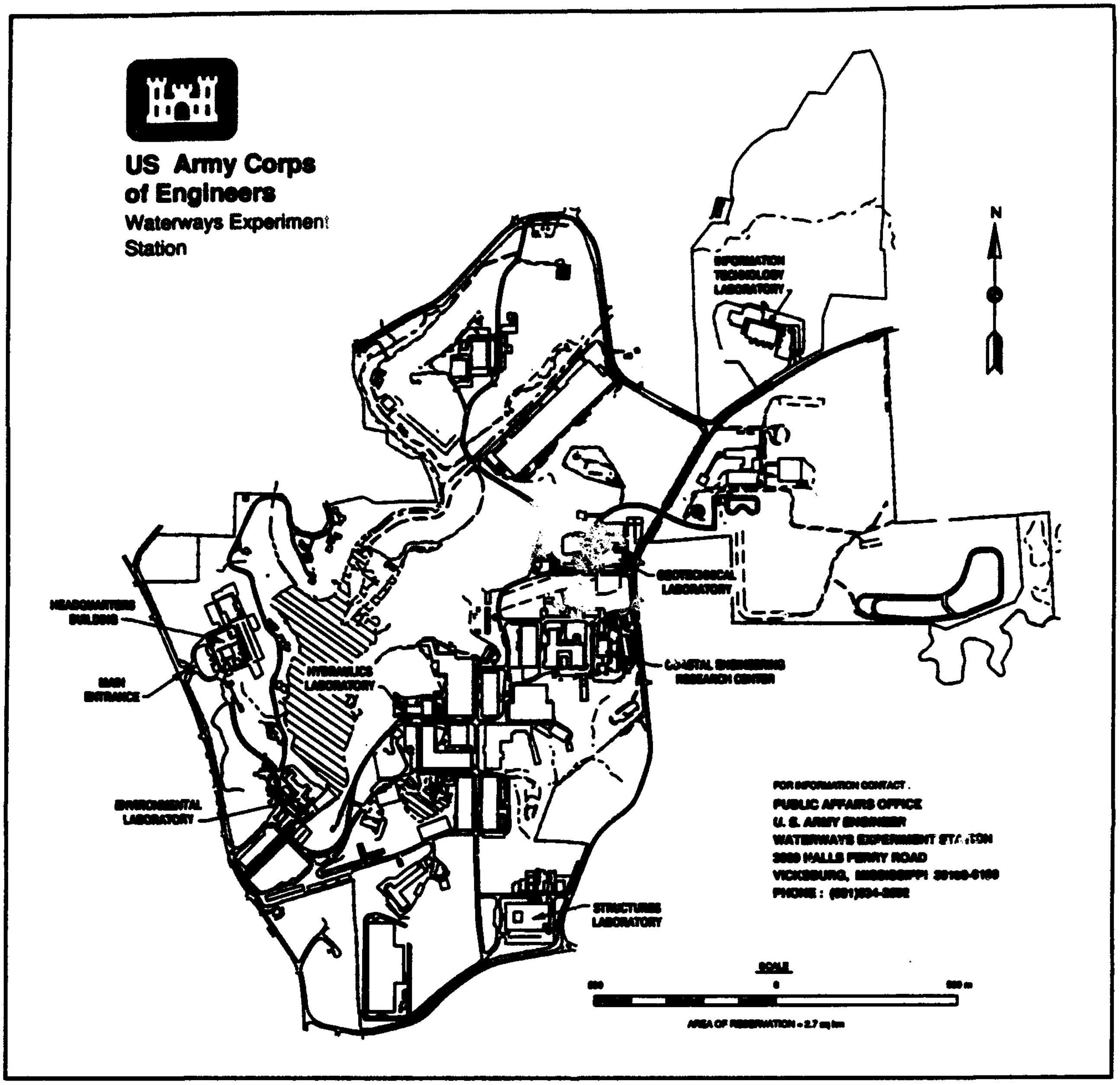

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Contents

Preface

This model investigation was conducted for the U.S. Army Engineer District, Mobile, by the U.S. Army Engineer Waterways Experiment Station (WES) during the period June 1979 to March 1985. The study was authorized by the Mobile District in a letter dated 20 September 1976 and in Order No. 77-0041, dated 26 January 1977.

The investigation was conducted under the general supervision of Messrs. H. B. Simmons, Chief of the Hydraulics Laboratory (retired); F. A. Herrmann, Jr., Director of the Hydraulics Laboratory; and R. A. Sager, Assistant Director of the Hydraulics Laboratory; and under the direct supervision of Messrs. J. E. Glover, Chief of the Waterways Division (retired), Hydraulics Laboratory; J. E. Foster, Chief of the River Regulation Branch (retired), Waterways Division; and C. W. O'Neal, Chief of the River Regulation Branch, Waterways Division. The engineer in immediate charge of the model was Mr. R. A. McCollum, River Regulation Branch, assisted by Ms. D. C. Derrick, Ms. D. K. Daniel, Ms. E. A. Hess, and Mr. D. J. Head, all of the River Regulation Branch. This report was prepared by Mr. McCollum assisted by Ms. Derrick. Representatives of the Mobile District who were actively involved in the study were Messrs. Wayne Odom, William Stubblefield, Bruce Murray, and Kenneth Underwood.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic meters
feet	0.3048	meters
inches	2.54	centimeters
miles (U.S. statute)	1.609347	kilometers

1 Introduction

Location and Description of Prototype

The Apalachicola River begins at the confluence of the Chattahoochie and Flint Rivers at the Georgia-Florida state line and flows south through the Florida panhandle to the Gulf of Mexico. The authorized project for the Apalachicola, Chattahoochie, and Flint Rivers provides for a 9-ft[1] deep by 100-ft wide navigation channel from Bainbridge, Georgia on the Flint River and Columbus, Georgia on the Chattahoochie River to the mouth of the Apalachicola River.

There are several troublesome reaches where there is difficulty in maintaining navigation depth. The reach in question is known as the Chipola Cutoff Reach (Figure 1), named for the Chipola Cutoff which diverts approximately 27 percent of the total flow away from the Apalachicola River to the Chipola River. Approximately 100,000 cubic yards is dredged annually to maintain the reach. Almost all of this amount comes from the area just downstream of the Chipola Cutoff. Sites for the disposal of the dredged material are rapidly being filled and new sites are difficult to obtain.

The area in question has relatively low overbank elevations which are overtopped by the river almost annually during high water. Diversion of flow from the Apalachicola River by the Chipola Cutoff reduces velocities and bed load sediment carrying capability in the reach just below the Cutoff. The discharge passing through the Chipola Cutoff causes considerable erosion of the banks along the Cutoff.

Need for and Purpose of Model Study

Due to continuing decline in suitable sites for disposal of dredge material, various alternative methods of dealing with dredge material and construction of channel contraction works were considered. Analytical methods of

[1] A table of factors for converting non-SI units of measurement to SI (metric) units is found on page v.

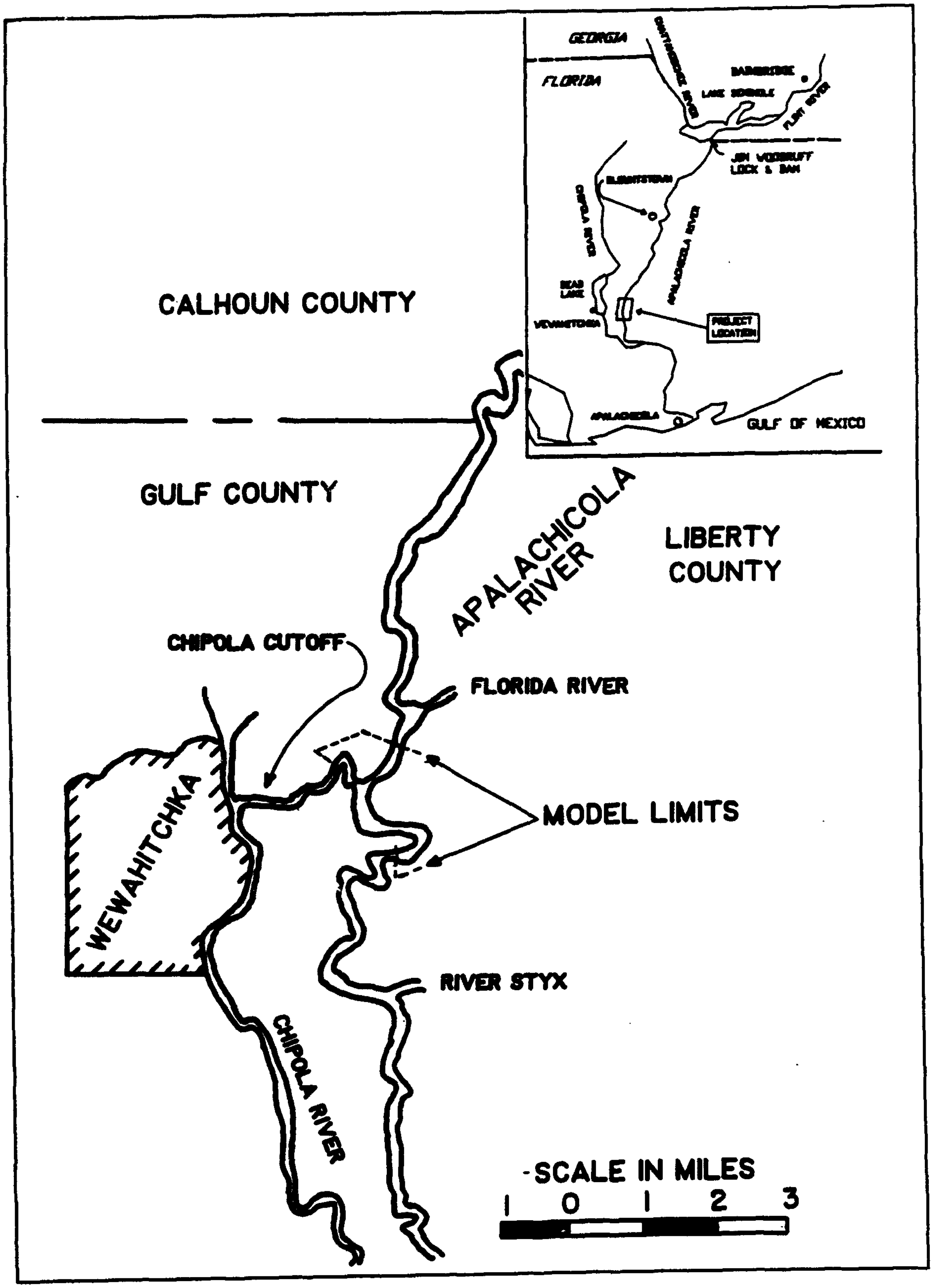

Figure 1. Vicinity and location maps

determining solutions would be difficult, if not impossible, therefore a model study was considered essential. Specifically, the purposes of the model study are:

a. Demonstrate the effects of Thalweg Disposal of dredged material.

b. Demonstrate the effects of Within-Bank Disposal of dredged material.

c. Develop a contraction works plan to eliminate or reduce the shoaling in the navigation channel from the Chipola Cutoff to navigation mile 40 and limit flow through the Chipola Cutoff to a maximum of 30 percent of the total flow.

2 The Model

Description

The Chipola Cutoff Reach, Apalachicola River model was of the movable-bed type, constructed to scales of 1:120 horizontally and 1:80 vertically. The model reproduced the reach of the Apalachicola River from navigation mile 42.7 to 39.5 and approximately one mile of the Chipola Cutoff (Plate 1). The overbank and bed were molded in crushed coal having a median grain diameter of 4 mm. and a specific gravity of 1.3. Fixed-bank line and bed rock were molded in crushed stone.

The fixed-bank line and overbank portions of the model were molded to the January 1978 Hydrographic Survey, the 1943-1944 Geological Survey, and the 1974 and 1976 aerial photographs. The movable-bed, at the start of the adjustment tests, was molded to the January 1978 Hydrographic Survey (Plate 2).

Appurtenances

Water was supplied to the model by a circulating flow system and was measured by a 6" x 3" venturi. Water-surface elevations throughout the model reach were measured by 12 piezometer gages. Tailwater elevations were controlled by 2 adjustable tailgates located at the end of the model and in the Chipola Cutoff Channel. Bed material was measured in a graduated container and introduced by hand at the upper end of the model. A sediment trap was provided at the lower end of the model and also in the Chipola Cutoff to collect any material leaving the model so it could be measured to determine the amount discharged for any period. Bed elevations in the model were obtained by the use of a surveying rod which permitted the reading of elevations in prototype feet. Sheet metal templates were used for molding the model bed prior to each adjustment test. Carefully graded rails along each side of the model provided support for the templates at the appropriate elevation, for the cross-rails used to survey the model bed, and to control the grade of structures during installation.

3 Tests and Results

Model Adjustment

Description

Before tests of the improvement plans were undertaken, the model was adjusted until it reproduced, with a reasonable degree of accuracy, the conditions shown by available prototype surveys. Model adjustment was accomplished by operating the model molded to the January 1978 Prototype Survey (Plate 2) and reproducing the prototype hydrograph (Plate 3) recorded between the dates of the prototype surveys of 1978 (Plate 2) and June 1979 (Plate 4). The adjustment test was repeated, modifying discharge, bed slope, and bed material introduction until a reasonable degree of accuracy between model and prototype configurations was achieved. The discharge allowed to flow through the Chipola Cutoff was held to 27 percent of the total discharge in the Apalachicola River above the Cutoff during model adjustment. During model plan testing, discharge through the cutoff was not maintained at 27 percent but was allowed to flow uncontrolled so that discharge passing through the Cutoff could be measured to determine the effects of contraction works at the entrance of the Cutoff on discharge entering the Cutoff.

Results

The results of the final adjustment test (Plate 5) when compared to the prototype survey of June 1979 indicated that the model generally reproduced scour and deposition tendencies of the prototype. However, the bends tended to be 2 to 3 ft deeper and the crossings and point bars about 2 to 3 ft higher than the prototype. This adjustment was considered to be acceptable for the testing program planned, but differences in model-prototype scour and fill elevations are considered in evaluating test results.

Base Test

Description

The base test was conducted with existing prototype conditions to determine the sedimentation trends that would develop in the model after two reproductions of the testing hydrograph. Before the start of the first hydrograph reproduction, the model was molded to the June 1979 prototype survey and the navigation channel dredged to 9 ft below the low-water reference plane (LWRP)[1]. The 1973-1974 typical water year hydrograph (Plate 6) was reproduced for each run. The second reproduction of the hydrograph used the ending bed configuration of the first hydrograph reproduction with no additional dredging.

Results

The results of the two hydrograph reproductions (Plate 7) indicated that the channel crossings at navigation miles 41.7 and 40.3 would fill and that shoaling would occur from the mouth of the Chipola Cutoff to mile 40.4. Shoaling was also noted on all of the bars in this reach.

Thalweg Disposal Tests

Description

Thalweg Disposal testing consisted of depositing dredged material in the deep area of the bendway channel from navigation mile 40.20 to 39.85 to an elevation 12 ft below the LWRP. The top of the deposited material in the bend was el 1 ft NGVD. This material was obtained from dredging in the area up to a distance of one mile upstream of the disposal site. The average prototype dredge material quantity for the area just upstream of the bend was 68,000 cubic yards. The conditions used for each test were as follows:

a. Test 1: The model bed was molded to the January 1979 bed configuration, the channel was dredged to 9 ft below the LWRP, and the model equivalent of the average quantity of material dredged in one year in the prototype was placed in the lower bend. The 1973-1974 average water-year hydrograph was reproduced.

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[1] Elevations (el) and stages cited herein are in feet are either the Lower Water Reference Plane (LWRP) or the National Geodetic Vertical Datum (NGVD) and will be respectively identified.

b. *Tests 2, 3, and 4:* The ending bed configuration of the preceeding Test, except for dredging of the navigation channel and filling the disposal site to its maximum storage capacity, was used. The 1973-1974 average water-year hydrograph was reproduced for each test.

c. *Test 5:* The ending bed configuration of Test 4, except for dredging of the navigation channel and filling the disposal site to its maximum storage capacity, was used for Test 5. The 1977-1978 high water-year hydrograph (Plate 8) was reproduced.

Results

The result of Tests 1 through 4 (Plates 9 through 12) indicated shoaling would continue along the right bank in the lower bend at a rate greater than that during the base test. Channel width and depth gradually decreased until there was a complete loss of the navigation channel at Mile 39.7. The amount of material that the bend would hold became increasingly smaller with each hydrograph. Sediment output at the end of the model continually increased with each hydrograph reproduction.

Test 5 (Plate 13), using the high water-year hydrograph, indicated that the shoaling at Mile 39.7 would be reduced in comparison to Tests 1 through 4, but overall channel width and depth did not improve. The results indicated that shoaling along the inside of the bend would continue to occur and the navigation channel would steadily shoal if the bend is used for disposal of dredged material.

Within-Bank Disposal Tests

Description

Within-bank disposal testing consisted of placing dredged material along the bank opposite the dredge cut from the treeline to within 100 ft of the navigation channel and to an elevation of no higher than 7 ft above the LWRP. The disposal areas were filled to capacity, which ranged up to a quantity equal to 3 years of average dredging. The conditions used for each test were as follows:

a. *Test 1:* The bed was molded to the January 1979 bed configuration, the channel dredged to 9 ft below the LWRP, and dredged material placed in the disposal sites. The 1973-1974 average water-year hydrograph was reproduced.

b. *Test 2:* The ending bed configuration of Test 1 was used, except for dredging of the navigation channel and adding disposal material to the deposit sites where necessary to bring the disposal sites up to maximum storage capacity. The 1973-1974 average water-year hydrograph was reproduced.

c. *Test 3:* The ending bed configuration of Test 2 was used, except for dredging of the navigation channel. No additional material was added to the disposal sites due to lack of erosion during Test 2. The 1973-1974 average water-year hydrograph was reproduced.

d. *Tests 4, 5, and 6:* The ending bed configuration of the preceding Test was used, except for dredging the navigation channel and adding dredged material to the disposal sites to bring them up to their maximum storage capacity. The 1977-1978 high water-year hydrograph was reproduced for each test.

Results

The results of Within-bank disposal Tests 1 through 3 (Plates 14 through 16) showed that the channel opposite the dredged material disposal site from navigation mile 41.5 to 40.8 would widen and deepen with each hydrograph. The large shoal area at Mile 40.6 was almost identical to the results of the base test. The inside of the lower bend shoaled and the navigation channel narrowed with some reduction of depth. The amounts of material dredged before each test was consistent in quantity with average prototype dredging.

In Tests 4 through 6 (Plates 17 through 19), which reproduced the 1977-1978 high water-year hydrograph, the channel from Mile 41.5 to 40.8 narrowed and shoaled as compared to Tests 1 through 3 using the average water-year hydrograph. The area at Mile 40.6 was basically unchanged. The channel in the lower bend deepened considerably, but channel width remained about the same as that of Test 3. The shoaling along the inside of the bend continued, but at a slower rate than during Tests 1 through 3. The amounts of material dredged before each test was almost the same as during Tests 1 through 3.

The overall results of Within-bank disposal testing indicated that disposal of dredged material within the river does not have a significant effect on the amount of dredging required to maintain the navigation channel. Some improvement of the navigation channel just below the Chipola Cutoff was noted during reproduction of the average water year hydrograph, but this gain was offset by the deterioration of the channel in the lower bend. Disposal material eroded very slowly from the disposal sites, much more slowly than the rate that material would be added from dredging.

Channel Contraction Works

Description

Various channel contraction works systems were tested in an attempt to develop and maintain the navigation channel with minimum maintenance. Plan A-1 (Plate 20), proposed by the Mobile District, was a system of 5 conventional spur and L-head dikes from navigation miles 40.8 to 40.3. The location (navigation miles), length (prototype feet), and elevations (feet NGVD) are as follows:

		Length		Elevation		
Location	Type	Spur	L-Section	Root	Channel	L-Section
40.80-.75L	Spur	250		20	10	
40.65L	Spur	300		20	10	
40.58L	Spur	280		20	10	
40.35R	L-head	100	100	20	15	10
40.24R	Spur	200		20	10	

This initial plan was modified and refined to develop Plan A-32 (Plate 21). This plan had extensive use of conventional spur, L-head, and vane dikes and also submerged sills. Locations, lengths, and elevations of all the training works used during Plan A-32 are listed in Table 1.

Plan A-42 is the final plan developed in the model. Plan A-42 consists of a system of 22 conventional spur and L-head dikes and 34 submerged vane dikes. Table 2 lists the location, length, and elevations of the structures of Plan A-42. All of the testing of Plans A-1 through A-41 used the 1973-1974 average water-year hydrograph. The final plan, A-42, was operated through five hydrographs. The first three used the 1973-1974 average water-year hydrograph, the fourth used the 1977-1978 high water-year hydrograph, and the fifth used the 1980-1981 low water-year hydrograph (Plate 22).

Plan A-42 has extensive use of submerged vane dikes, sometimes referred to as "Iowa Vanes". These vane dikes were initially installed according to the guidelines developed at the Institute of Hydraulic Research, University of Iowa by Drs. A. Jacob Odgaard and John F. Kennedy. Their research into submerged vanes was directed toward developing a system of structures that would help reduce the secondary currents that undermine and erode outside (concave) banklines. Their research showed that by the use of these vanes, the normally deep, narrow channel along the outside of a bend would develop into a wider, shallower channel due to the dispersion of the secondary currents into a more uniform velocity across the channel. This initial system was then modified to develop a system of submerged vanes to work in coordination with conventional dikes to develop and maintain an adequate navigation channel in the bendways of the Chipola Cutoff Reach.

Results

Tests results of Plan A-32 (Plate 21) indicated that this plan would not adequately develop and maintain the required navigation channel. A large shoaled area developed below the Chipola Cutoff at Mile 41.4 and shoaling at Miles 40.9, 39.9, and 39.7 restricted channel width. This plan had the most extensive use of conventional channel training works (spur, L-head, and vane dikes and submerged sills).

Test results of Plans A-42, Runs 1 through 3 (Plates 23 through 25), using the 1973-1974 average water-year hydrograph indicate the navigation channel will develop and maintain itself without dredging. Plan A-42, Run 4 (Plate 26) indicated shoaling following a high water year at navigation miles 41.00 and 39.90. This deposition was only from 1 to 2 ft above minimum navigation depth. Plan A-42, Run 5 (Plate 27) indicated the channel could maintain itself during a low-water year. The marginal depth areas that occurred during Plan A-42, Run 4 were reduced in size or eliminated during reproduction of the low-water hydrograph without dredging between the plan runs. Discharge in the Chipola Cutoff was reduced to 11 percent of the total flow at 11,000 cfs and was a maximum of 27 percent at a total river flow of 111,000 cfs.

4 Conclusions

The limitations of the model in reproducing all of the factors affecting developments in the reach and the differences between the model and prototype indicated by the results of the verification tests must be considered in the evaluation of model results. The model was not able to reproduce all of the overbank and the flow that passes over the banks during flood stages. The model also tended to scour deeper in the bendways and shoal higher on the point bars than the prototype surveys indicated. In spite of these limitations, adjustment and verification of the model were considered sufficient to indicate trends that can be expected under the conditions imposed for each plan or modification tested and the relative effectiveness of each plan.

Conclusions reached from the study are summarized as follows:

a. Thalweg disposal of dredged material will have little effect on channel dredging requirements.

b. Disposal material placed in the thalweg of the lower bend (navigation mile 40.20 to 39.85) tends to remain in place. Some increase of material passing out of the bend was noted.

c. The capacity of the bend for storage of dredged material decreases with each hydrograph.

d. Within-bank disposal of dredged material will have little effect on channel dredging required to maintain the navigation channel.

e. Within-bank disposal improves the channel from navigation mile 41.5 to 40.8 but deteriorates the channel in the lower bend (navigation mile 40.20 to 39.70) during average water years.

f. The channel will deteriorate following high water years with within-bank disposal.

g. Once filled, within-bank disposal will provide little or no additional storage capacity for dredged material due to the lack of erosion at these sites.

h. The system of conventional spur, L-head, and vane dikes and submerged sills used in Plan A-32 will not provide an adequate navigation channel.

i. The system of spur, L-head, and submerged vane dikes (Plan A-42) will develop and maintain an adequate navigation channel throughout the model reach except for some possible shoaling of material at navigation mile 41.1 and 39.9 following a high water year.

Table 1
Wewahitchka Reach, Navigation Miles 42.7 to 39.5, Apalachicola River
Plan A-32 Dikes

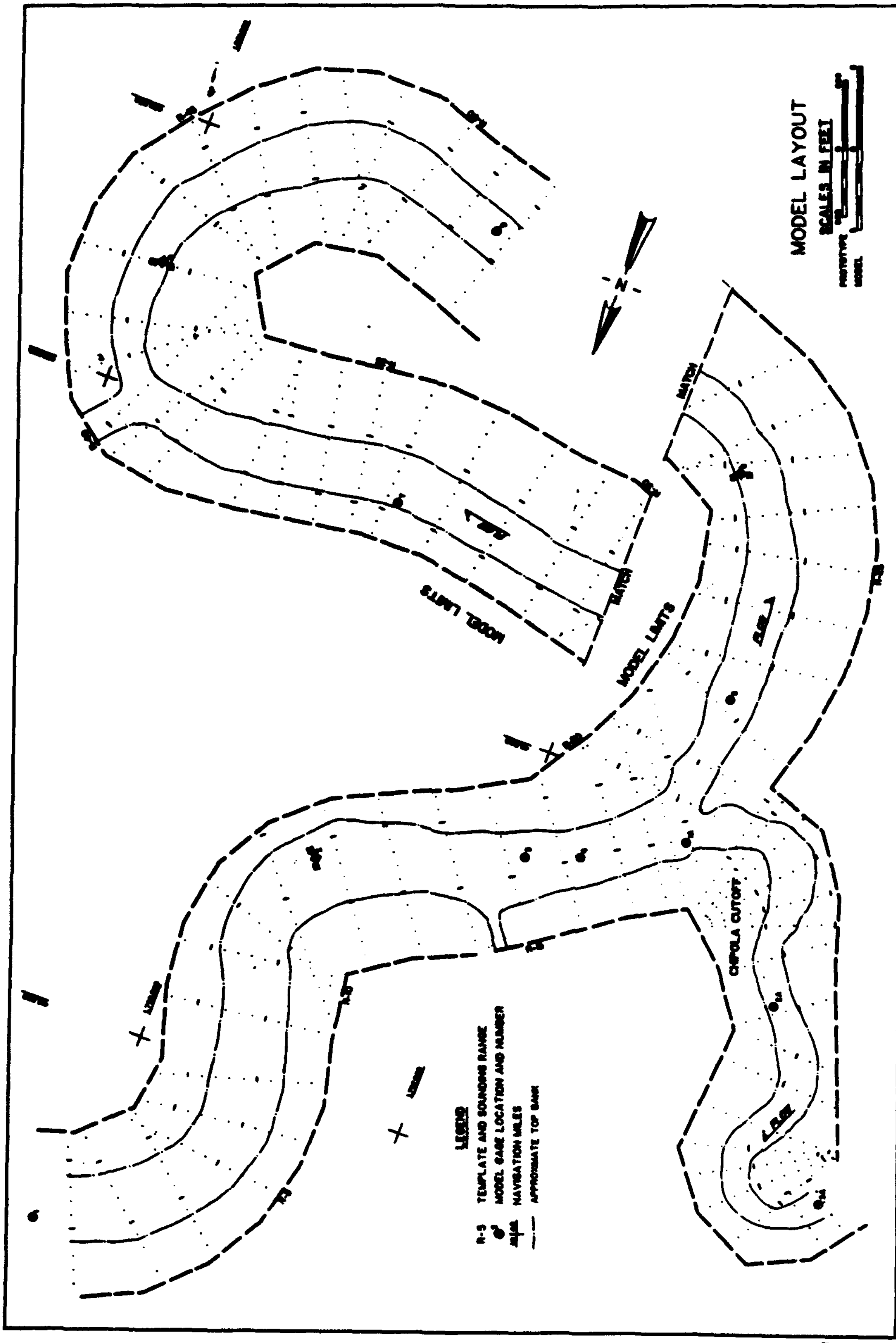
LOCATION NAV MILES	TYPE	LENGTH* SPUR	LENGTH* L	ELEVATION* ROOT	ELEVATION* CHANNEL	ELEVATION* L
41.81-.77L	TRANSITIONAL DIKE	300		20	20	
41.70L	SPUR DIKE	270		20	20	
41.64R	SUBMERGED SILL	(TOE OF RIGHT BANK TO LEFT BANK @ EL. 0)				
41.60R	SUBMERGED SILL	(TOE OF RIGHT BANK TO LEFT BANK @ EL. 0)				
41.56R	SUBMERGED SILL	150 (FROM TOE OF LONG. DIKE @ EL. 0)				
41.56-.47R	LONGITUDINAL DIKE	520		22	20	
41.53L	SPUR DIKE	200		20	20	
41.52R	SUBMERGED SILL	150 (FROM TOE OF LONG. DIKE @ EL. 0)				
41.49L	L-HEAD DIKE	150	200	20	20	20
41.47R	SUBMERGED SILL	150 (FROM TOE OF LONG. DIKE @ EL. 0)				
41.36R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
41.36L	SPUR DIKE	100		17	17	
41.26R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
41.26L	SPUR DIKE	100		17	17	
41.15R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
41.15L	SPUR DIKE	100		17	17	
41.09R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
41.09L	SPUR DIKE	100		17	17	
41.00R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
41.00L	SPUR DIKE	100		17	17	
40.92R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
40.92L	SPUR DIKE	100		17	17	
40.77-.73L	L-HEAD DIKE	200	220	21	17	17
40.64-.59L	L-HEAD DIKE	200	220	25	17	17
40.56L	VANE DIKE	100		17	17	
40.53-.48L	L-HEAD DIKE	170	230	22	17	17
40.43R	SUBMERGED SILL	(TOE OF RIGHT BANK TO TOE OF SPUR DIKE @ EL. 0)				
40.43L	SPUR DIKE	100		17	17	
40.35-.29R	LONGITUDINAL DIKE	300		17	17	
40.27-.21R	LONGITUDINAL DIKE	300		16	16	
40.17L	SUBMERGED SILL	(TOE OF LEFT BANK TO RIGHT BANK @ EL. 0)				
40.08L	SUBMERGED SILL	(TOE OF LEFT BANK TO RIGHT BANK @ EL. 0)				
40.00L	SUBMERGED SILL	(TOE OF LEFT BANK TO RIGHT BANK @ EL. 0)				
39.94R	SPUR DIKE	330		20	15	
39.91L	SUBMERGED SILL	(TOE OF LEFT BANK TO RIGHT BANK @ EL. 0)				
39.81L	SUBMERGED SILL	(TOE OF LEFT BANK TO RIGHT BANK @ EL. 0)				
39.72R	SPUR DIKE	230		20	15	

* NOTE: Dike lengths are in prototype feet and are measured from root to channel end (spur) and from channel end to downstream end of L-head dikes (L). All elevations are referred to NGVD (National Geodetic Vertical Datum).

Table 2
Wewahitchka Reach, Navigation Miles 42.7 to 39.5, Apalachicola River
Plan A-42 Dikes

LOCATION NAV MILES	TYPE	LENGTH* SPUR	LENGTH* L	ELEVATION* ROOT	ELEVATION* CHANNEL	ELEVATION* L
41.79L	TRANSITIONAL DIKE	350		20		
41.70L	TRANSITIONAL DIKE	320		20		
41.60L	VANE DIKE	180		20		
41.56-41.47R	LONGITUDINAL DIKE	590		25		
41.53-41.47L	L-HEAD DIKE	690	210	305'@17 & 385'@25		20
41.39L	SPUR DIKE	520		420'@17 & 100'@25		
41.29L	SPUR DIKE	420		22		
41.28R	SUBMERGED VANE	100		0		
41.24R	SUBMERGED VANE	100		0		
41.19L	SPUR DIKE	290		190'@17 & 100'@22		
41.18R	SUB VANE(2 PARALLEL)	100		0		
41.12R	SUB VANE(2 PARALLEL)	100		0		
41.08L	SPUR DIKE	310		210'@17 & 100'@22		
41.07R	SUB VANE(2 PARALLEL)	100		0		
41.01L	SPUR DIKE	250		22		
41.00R	SUB VANE(2 PARALLEL)	100		0		
40.94R	SUB VANE(2 PARALLEL)	100		0		
40.92L	SPUR DIKE	370		270'@17 & 100'@22		
40.90R	SUB VANE(2 PARALLEL)	100		0		
40.86R	SUB VANE(2 PARALLEL)	100		0		
40.77L	L-HEAD DIKE	230	250	21	17	17
40.66L	L-HEAD DIKE	210	250	25	17	17
40.58L	VANE DIKE	100		17		
40.51L	L-HEAD DIKE	160	200	22	17	17
40.43L	VANE DIKE	100		17		
40.43	SUB SILL (FROM TOE OF VANE DIKE TO TOE OF RIGHT BANK @ EL 0)					
40.32R	TRANSITIONAL DIKE	280		17		
40.12L	SUB VANE(2 PARALLEL)	100		0		
40.08R	TRANSITIONAL DIKE	270		15		
40.08L	SUB VANE(2 PARALLEL)	100		0		
40.01L	SUB VANE(2 PARALLEL)	100		0		
39.95L	SUB VANE(2 PARALLEL)	100		0		
39.92R	SPUR DIKE	360		20	15	
39.91L	SUB VANE(2 PARALLEL)	100		0		
39.86L	SUB VANE(2 PARALLEL)	100		0		
39.84R	SPUR DIKE	190		15		
39.81L	SUB VANE(2 PARALLEL)	100		0		
39.78R	SPUR DIKE	250		15		
39.72L	SUB VANE(2 PARALLEL)	100		0		
39.71R	SPUR DIKE	200		15		
39.66L	SUB VANE(2 PARALLEL)	100		0		

*NOTE: Dike lengths are in prototype feet and are measured from root to channel end (spur) and from channel end to downstream end of L-head dikes (L). All elevations are referred to NGVD (National Geodetic Vertical Datum).



MODEL LAYOUT
SCALES IN FEET
PROTOTYPE
MODEL
MODEL LIMITS
MODEL LIMITS
MATCH
MATCH
CHIPOLA CUTOFF
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
APPROXIMATE TOP BANK

Plate 1

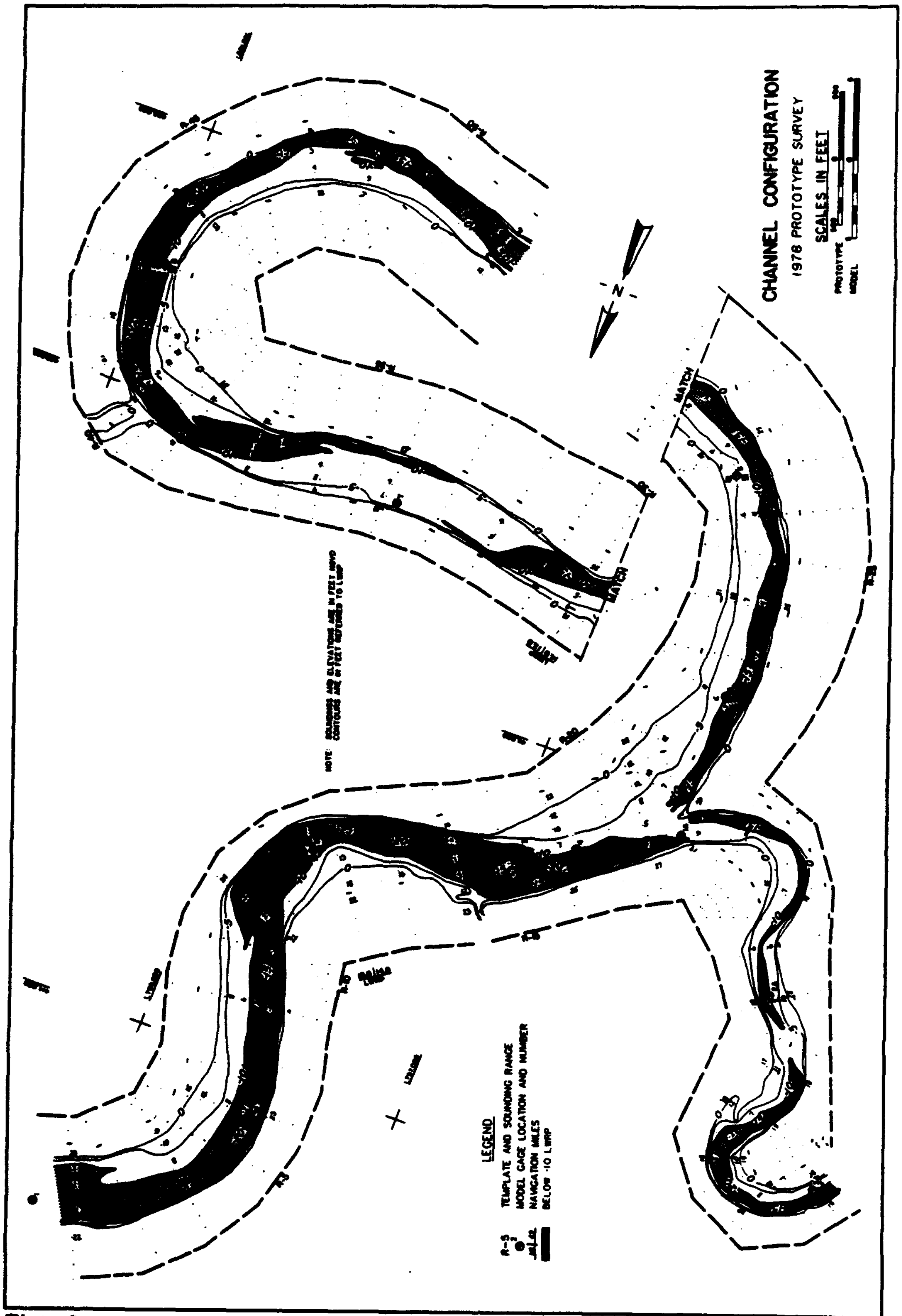
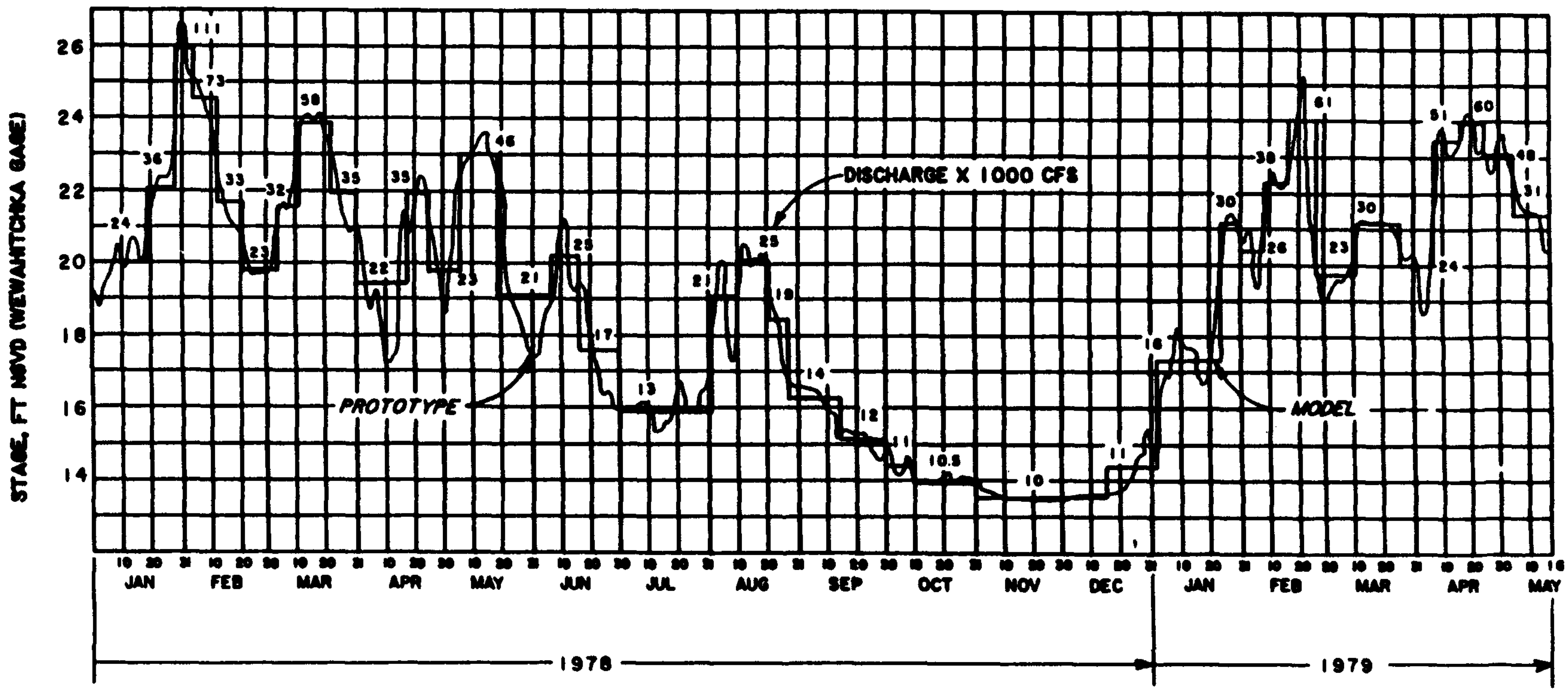

CHANNEL CONFIGURATION
1978 PROTOTYPE SURVEY
SCALES IN FEET
PROTOTYPE
MODEL
MATCH
MATCH
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
BELOW -10 LWRP

Plate 2



ADJUSTMENT HYDROGRAPH

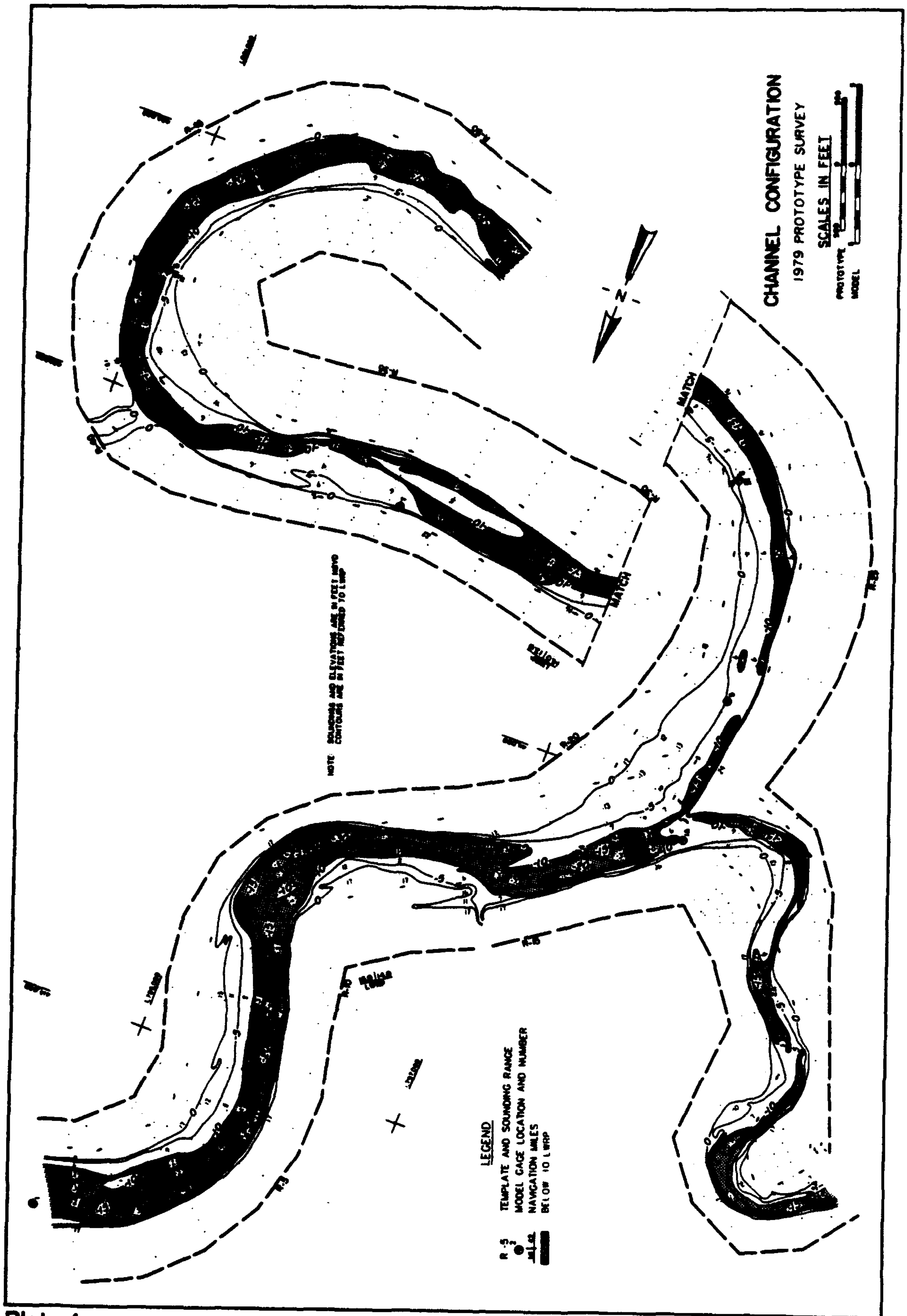

CHANNEL CONFIGURATION
1979 PROTOTYPE SURVEY
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
BELOW 10 LWRP
MATCH
MATCH
N

Plate 4

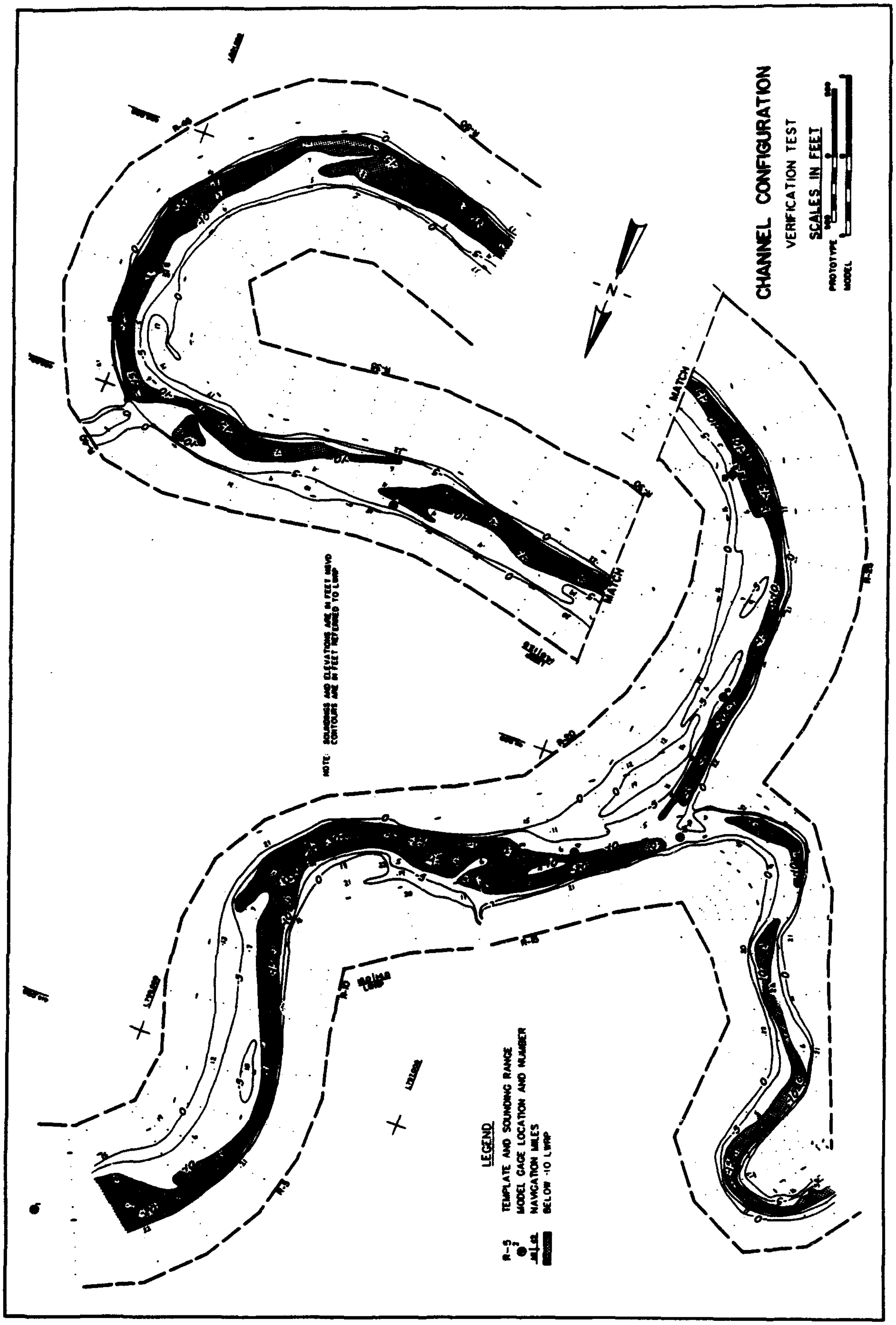
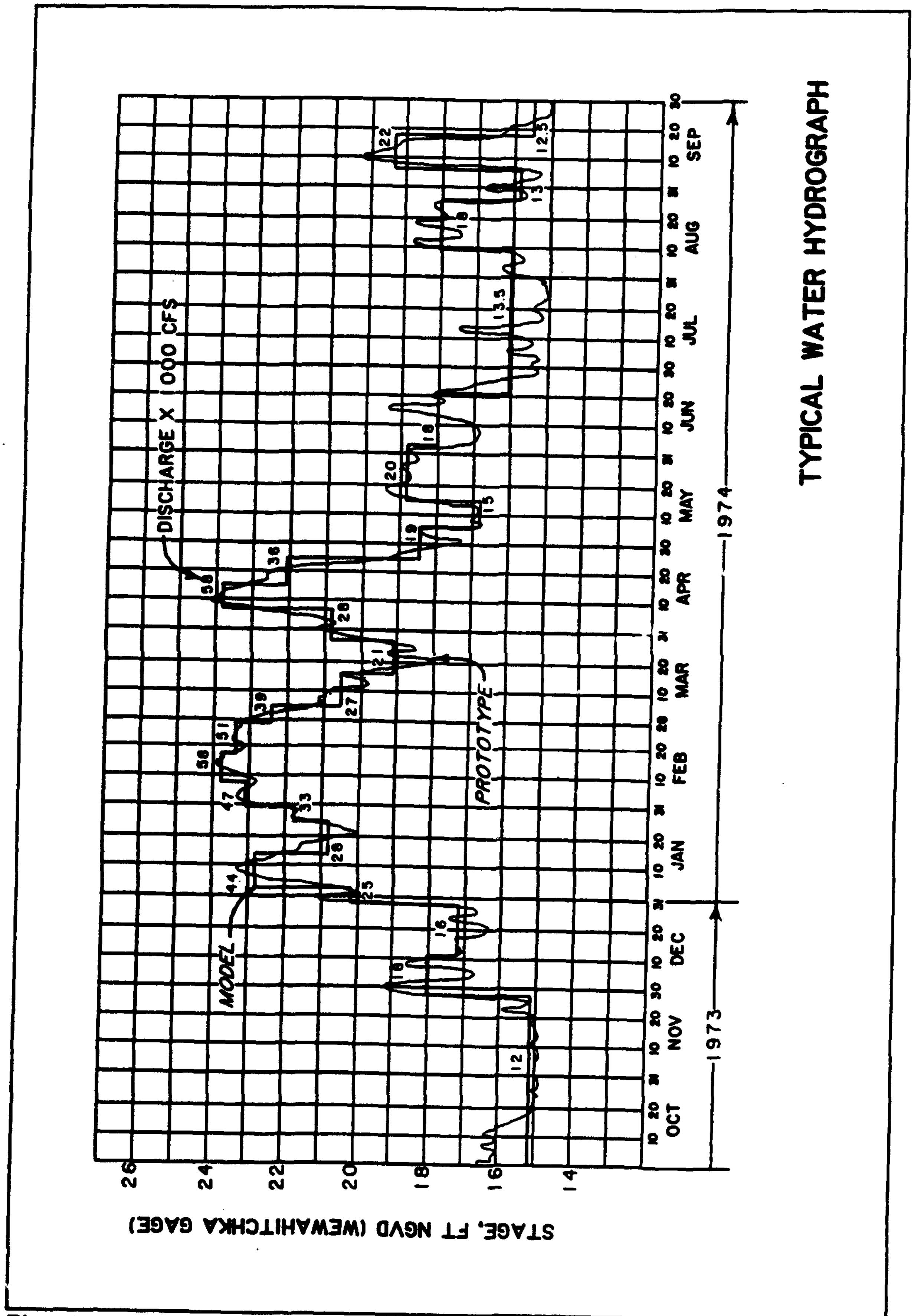

CHANNEL CONFIGURATION
VERIFICATION TEST
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH

Plate 5



TYPICAL WATER HYDROGRAPH

Plate 6

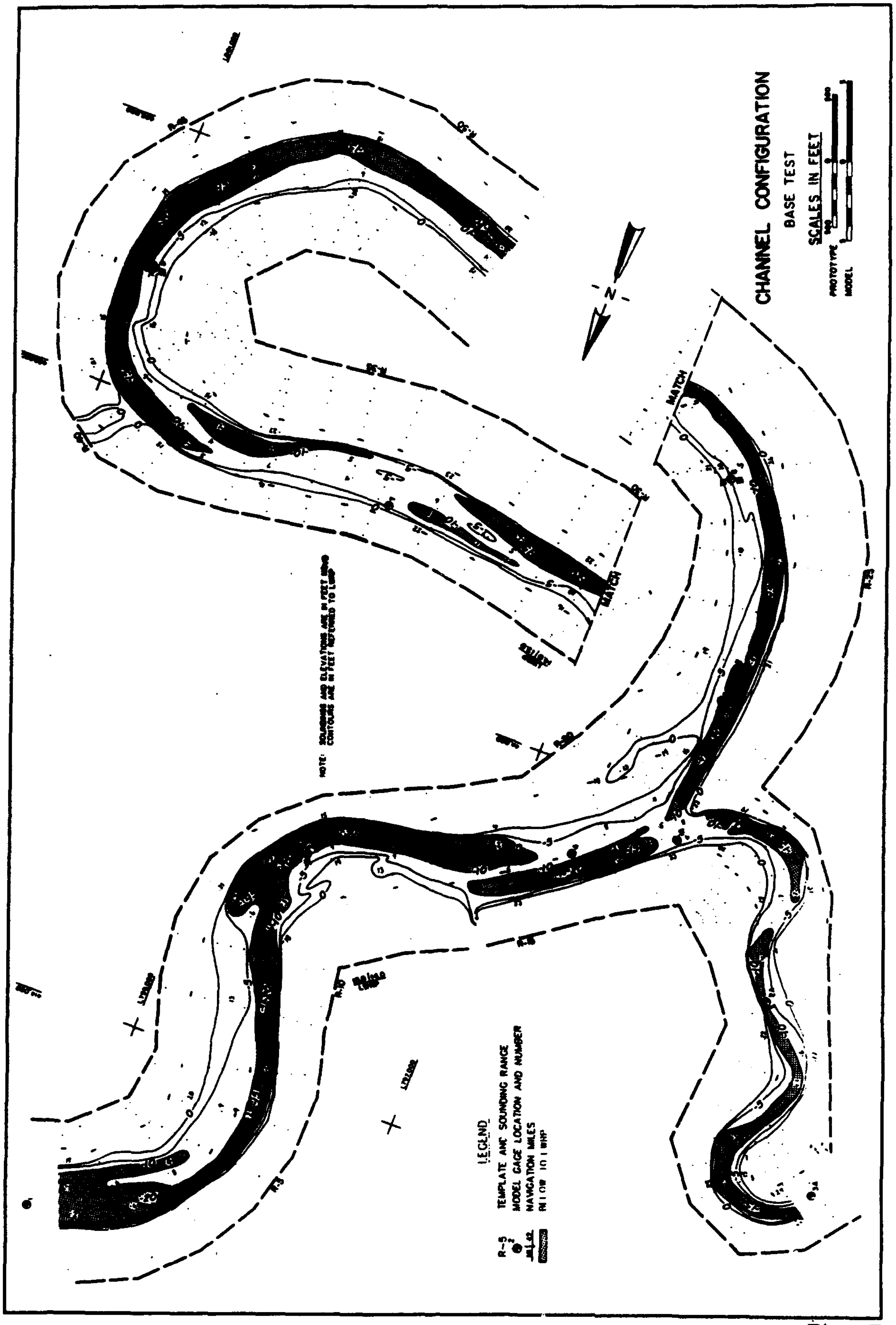
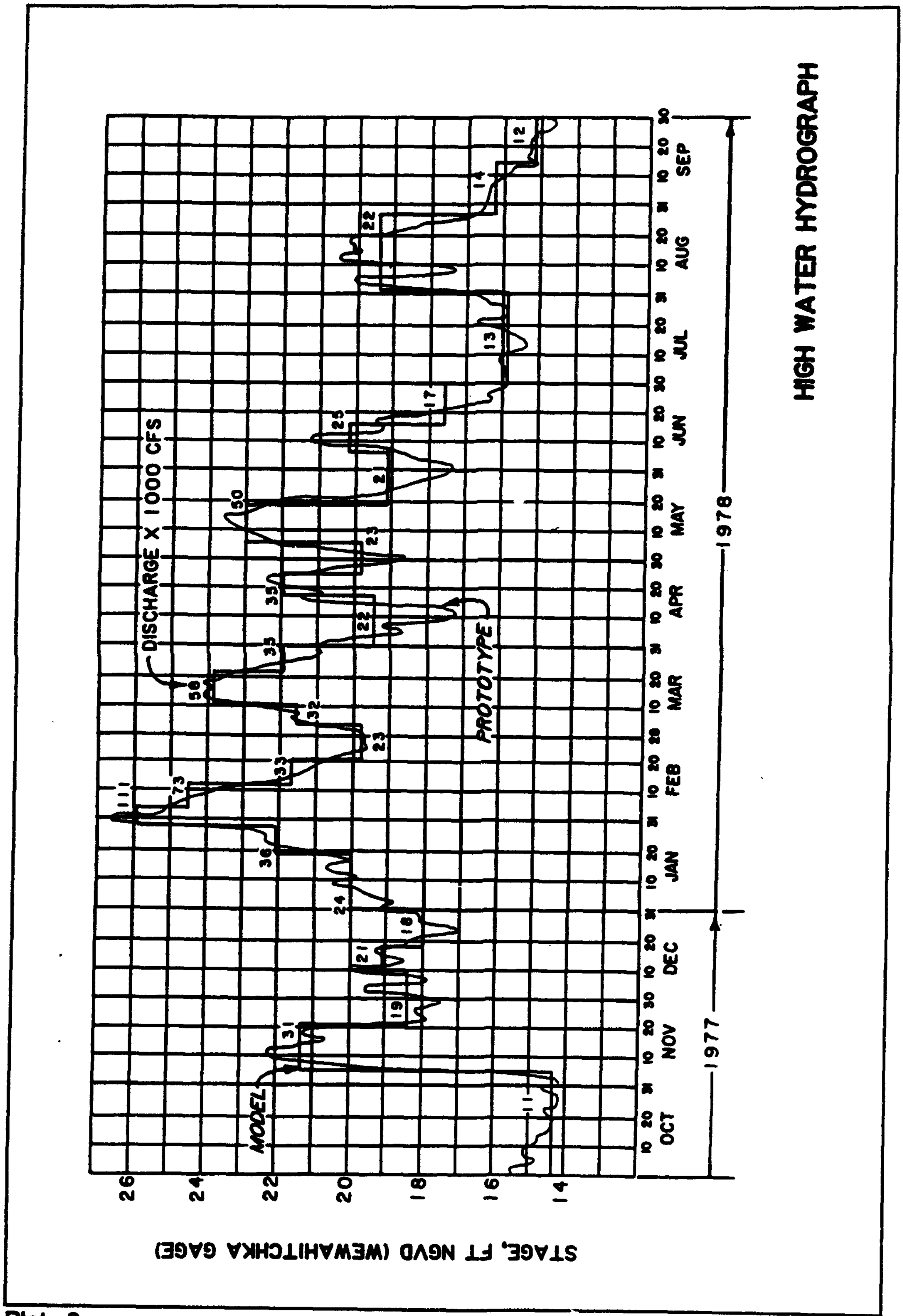
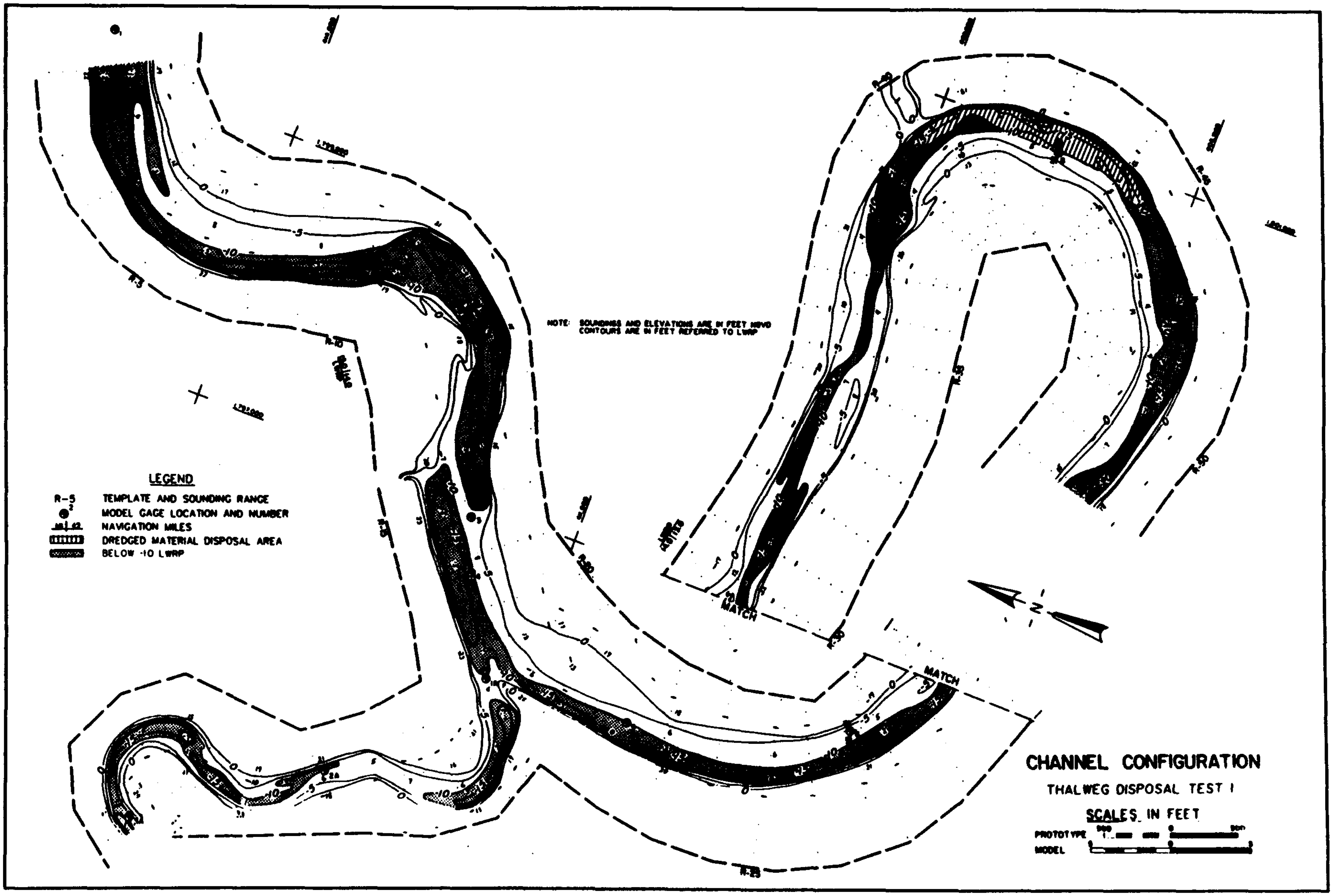

CHANNEL CONFIGURATION
BASE TEST
SCALES IN FEET
PROTOTYPE
MODEL
MATCH
MATCH
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES

Plate 7



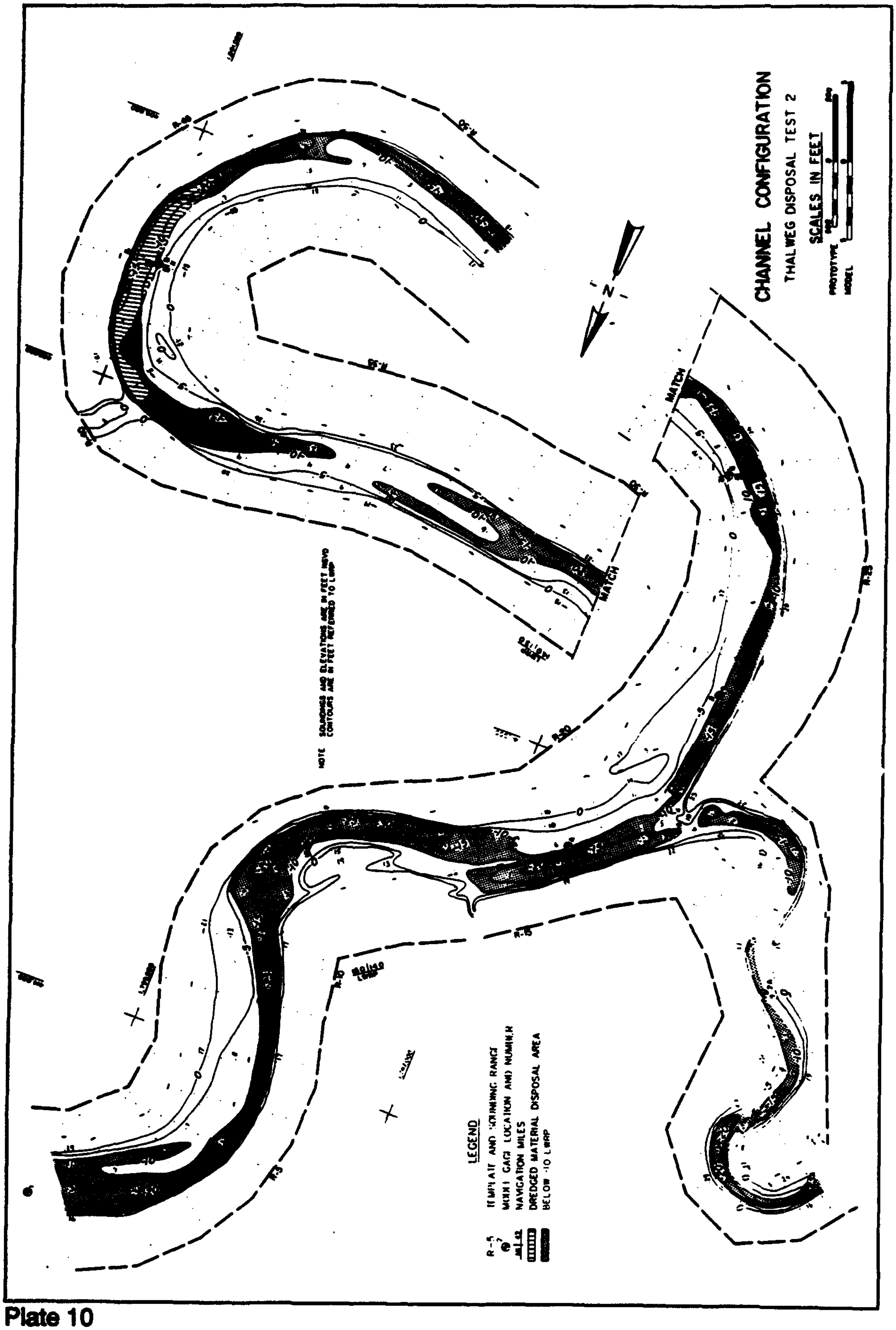
HIGH WATER HYDROGRAPH
STAGE, FT NGVD (WEWAHITCHKA GAGE)
26
24
22
20
18
16
14
DISCHARGE X 1000 CFS
MODEL
PROTOTYPE
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
1977
1978

Plate 8



CHANNEL CONFIGURATION
THALWEG DISPOSAL TEST I

Plate 9



CHANNEL CONFIGURATION
THALWEG DISPOSAL TEST 2
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
NOTE SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH

Plate 10

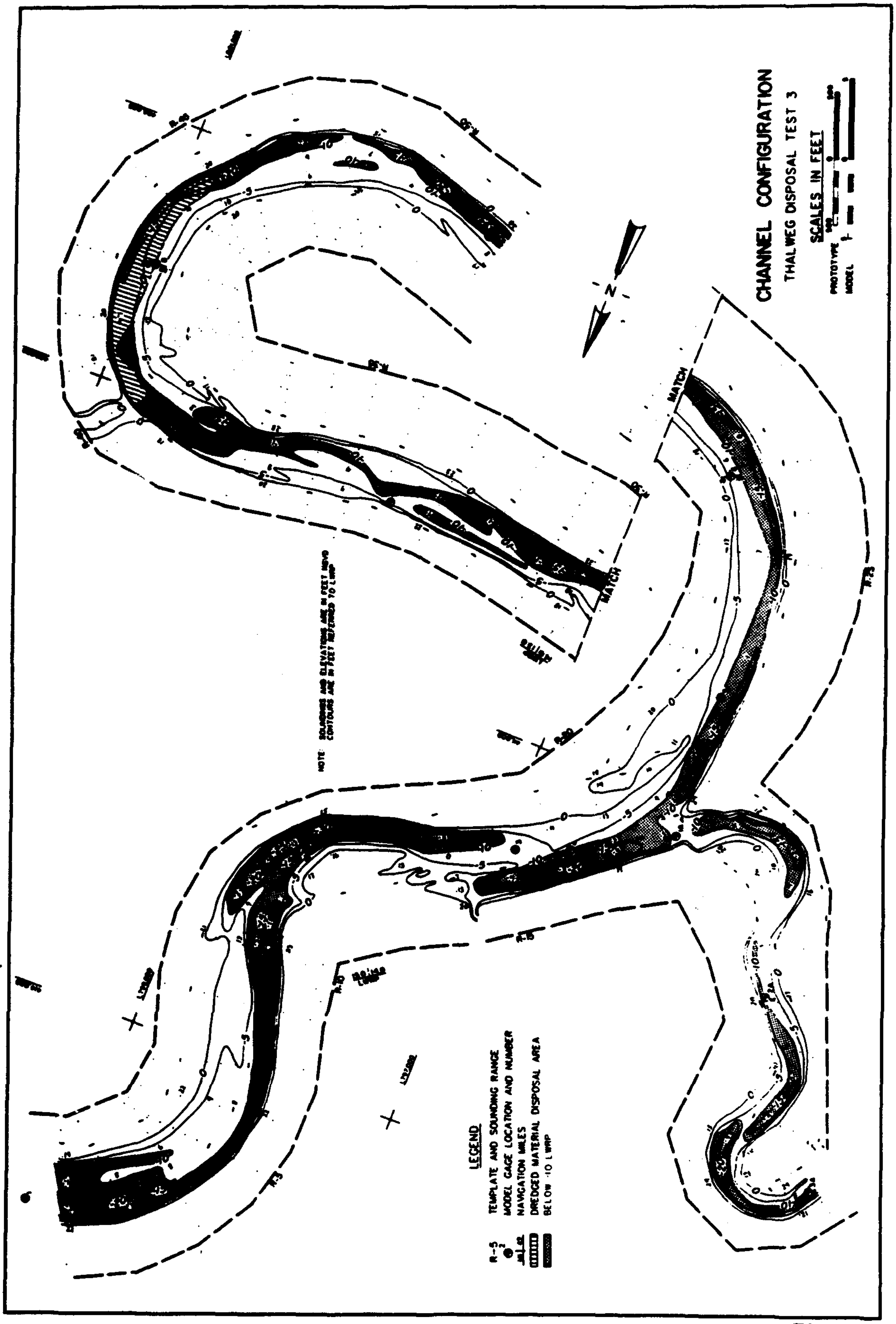

CHANNEL CONFIGURATION
THALWEG DISPOSAL TEST 3
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
MATCH
MATCH

Plate 11

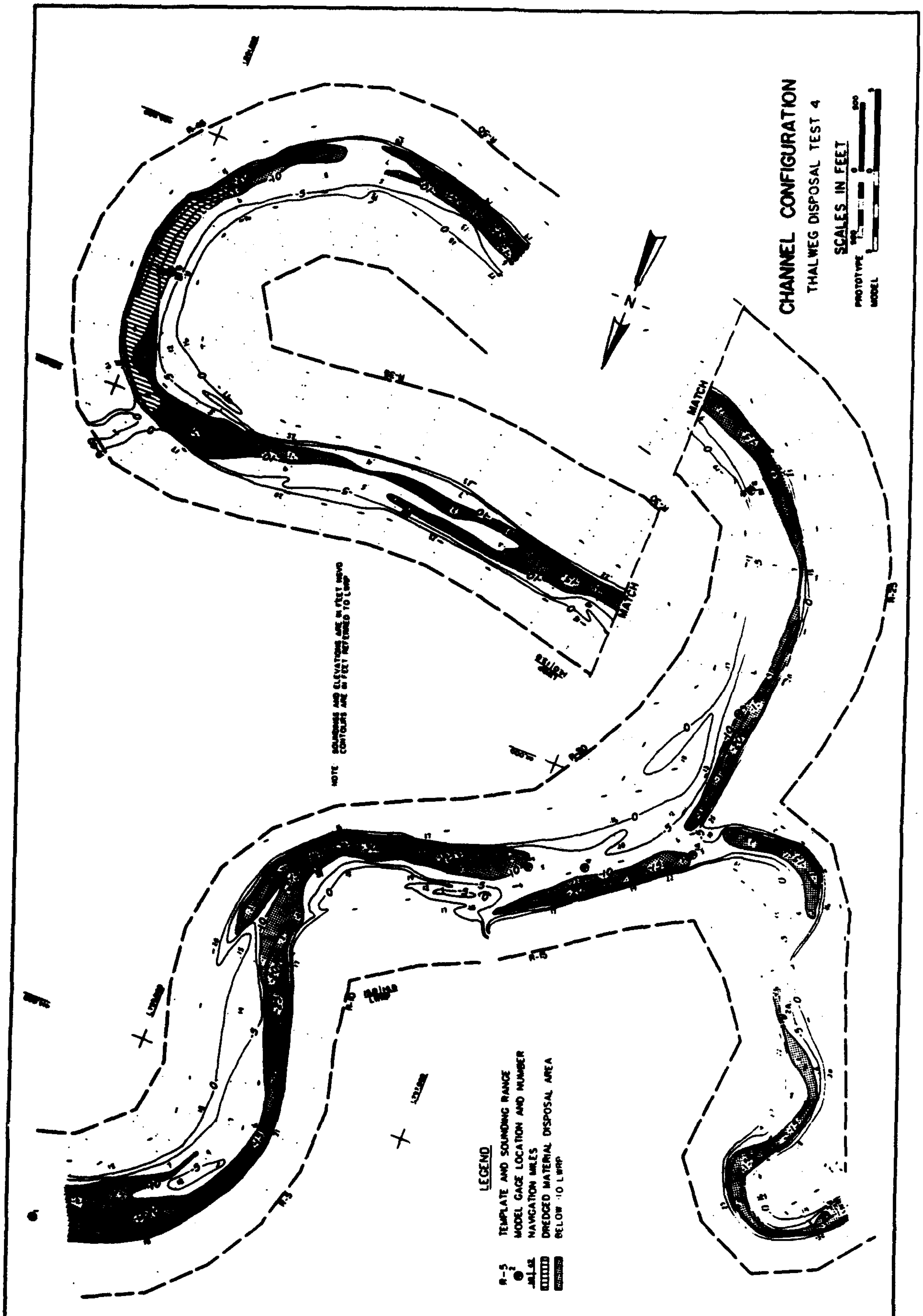
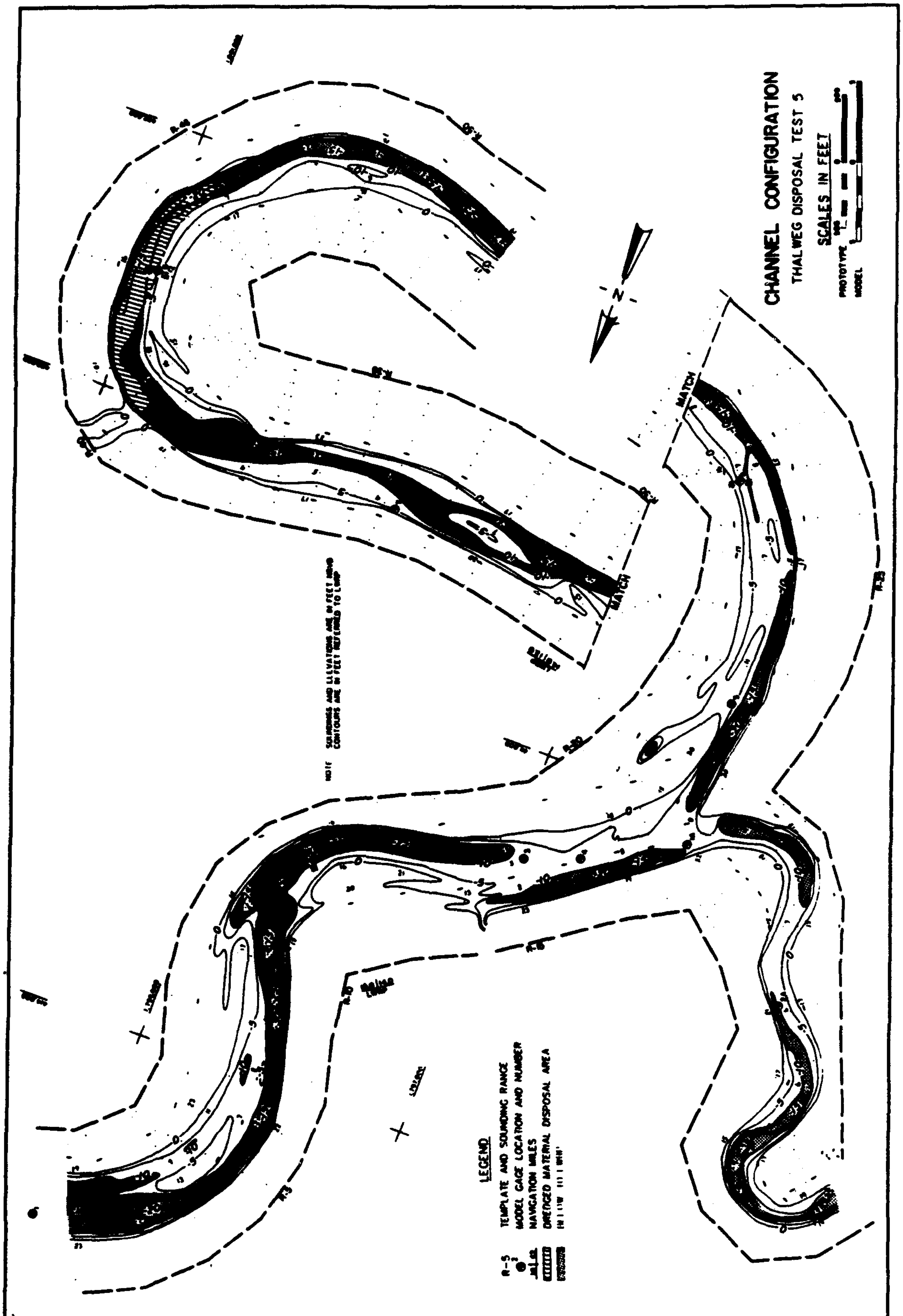

CHANNEL CONFIGURATION
THALWEG DISPOSAL TEST 4
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
NOTE SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH

Plate 12


CHANNEL CONFIGURATION
THALWEG DISPOSAL TEST 5
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
MATCH
MATCH

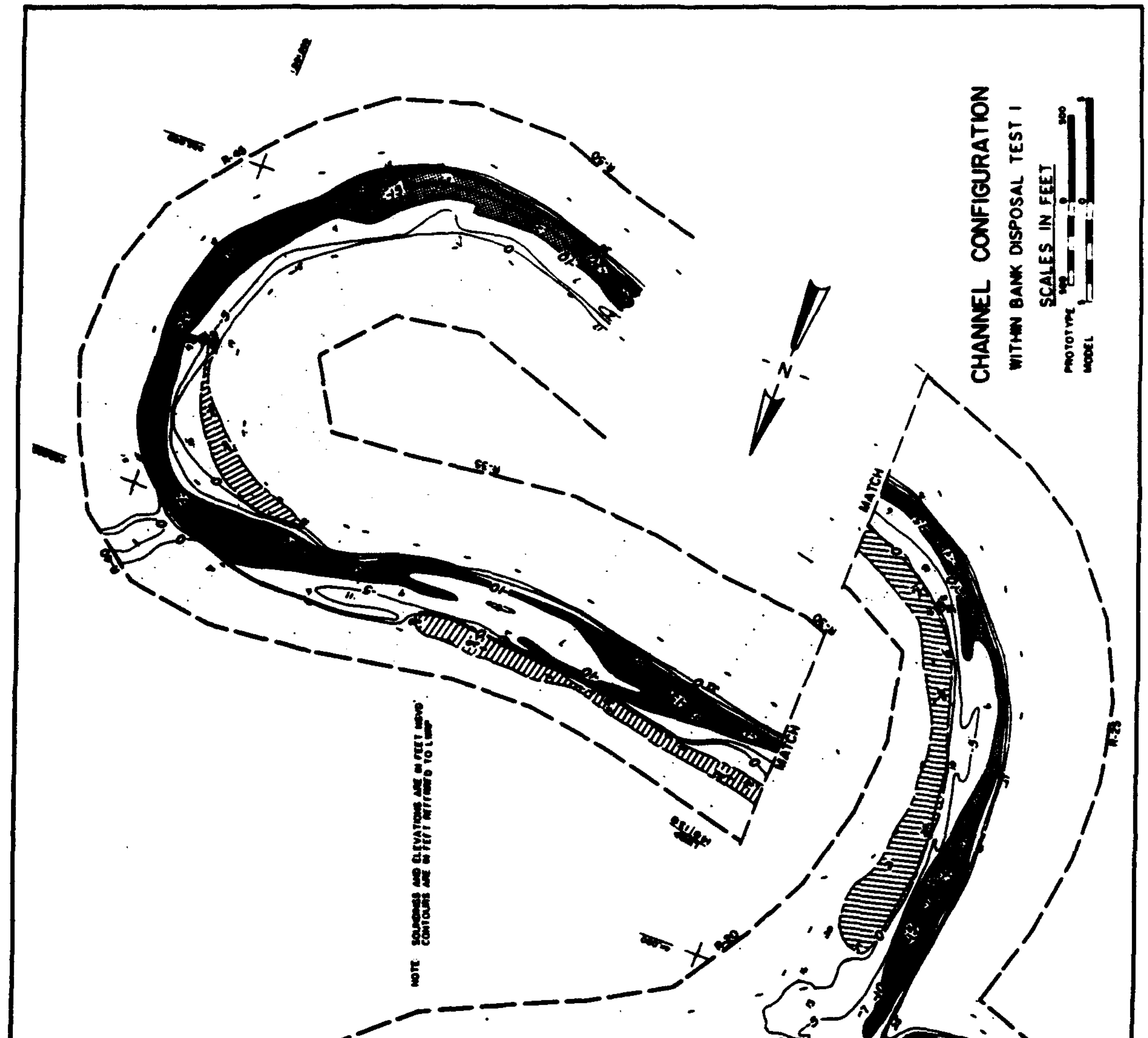
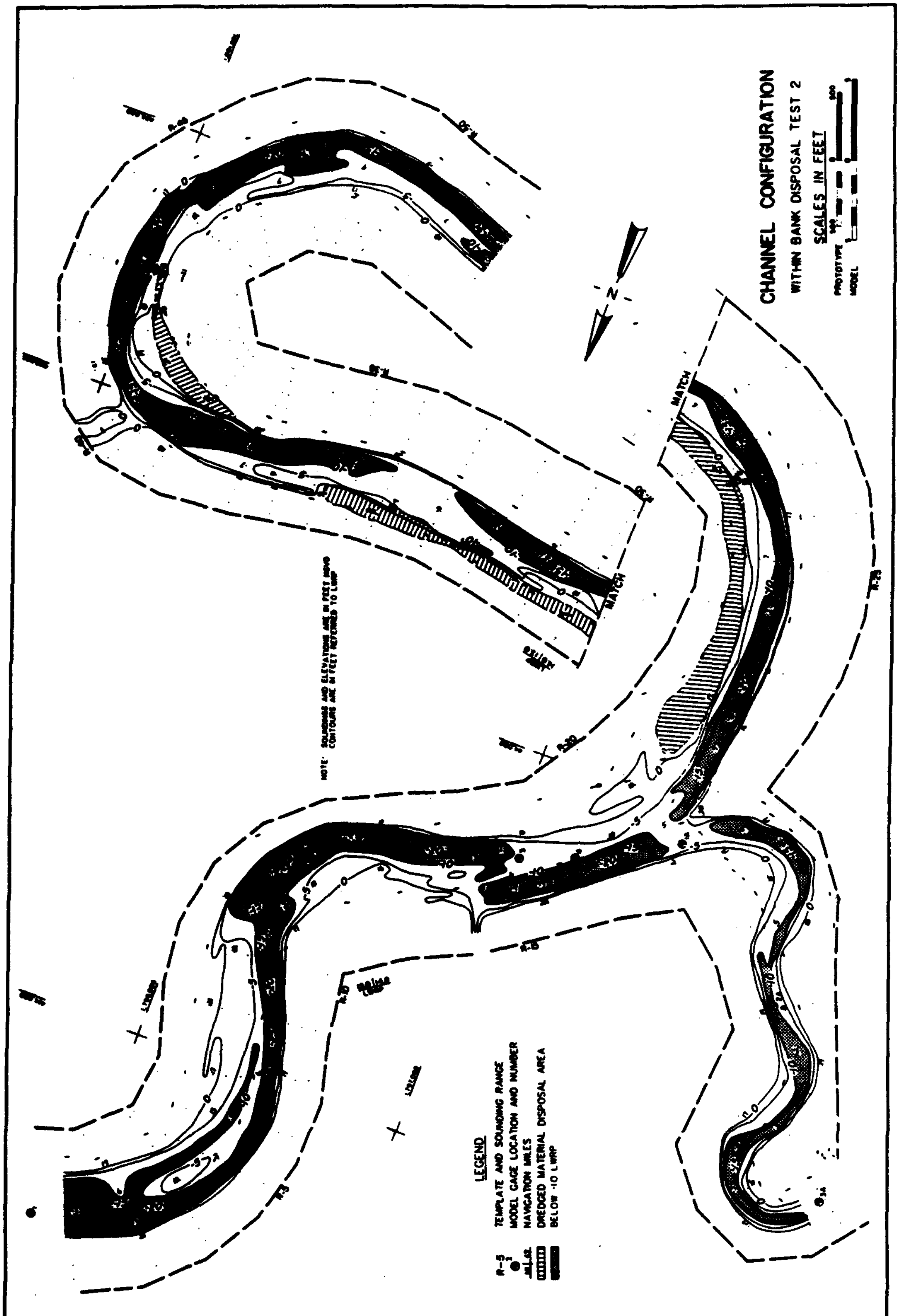

CHANNEL CONFIGURATION
WITHIN BANK DISPOSAL TEST I
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
MATCH
MATCH

Plate 14


CHANNEL CONFIGURATION
WITHIN BANK DISPOSAL TEST 2
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH
N
R-3
R-10
R-15
R-25
R-30
R-35
R-50

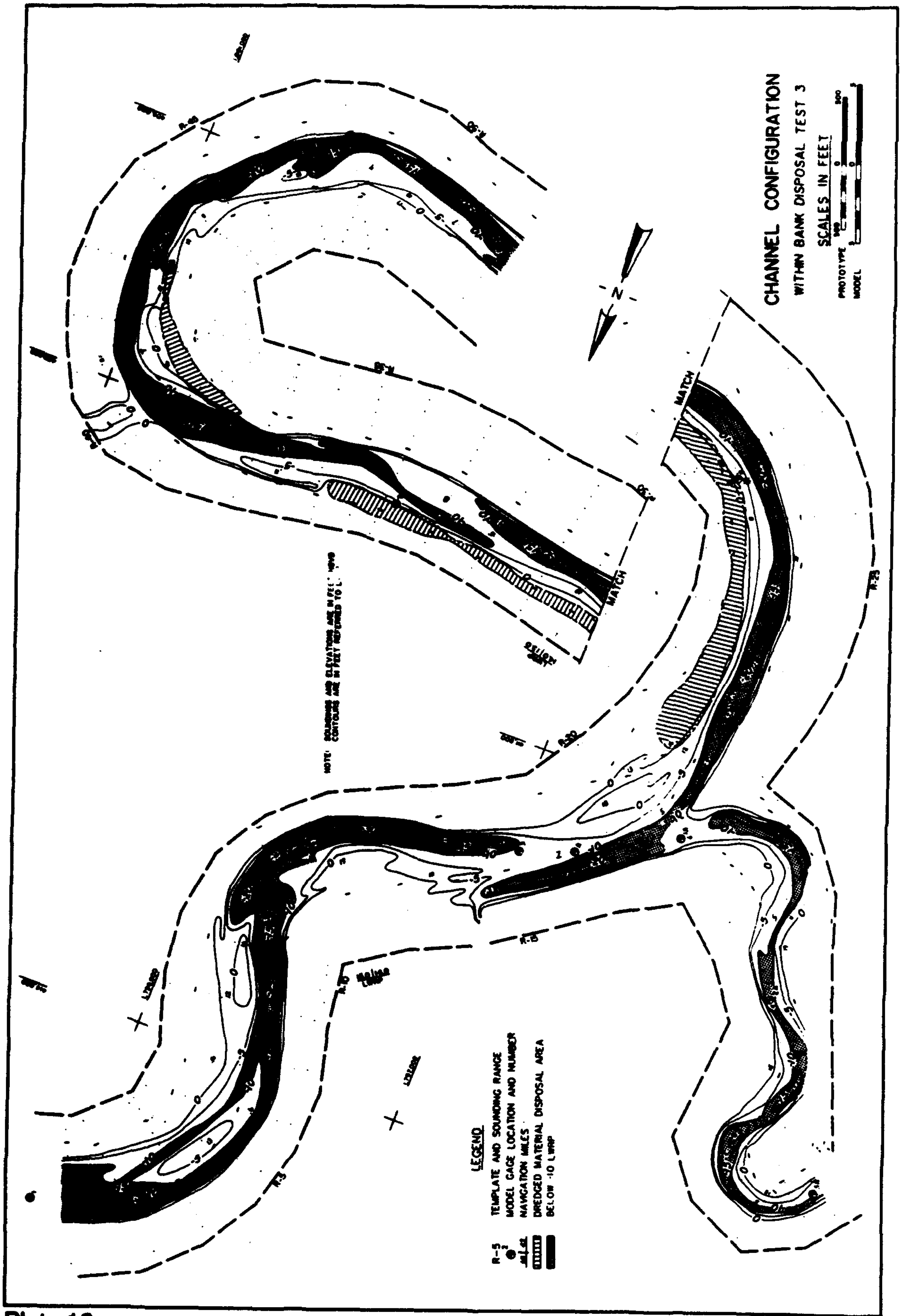
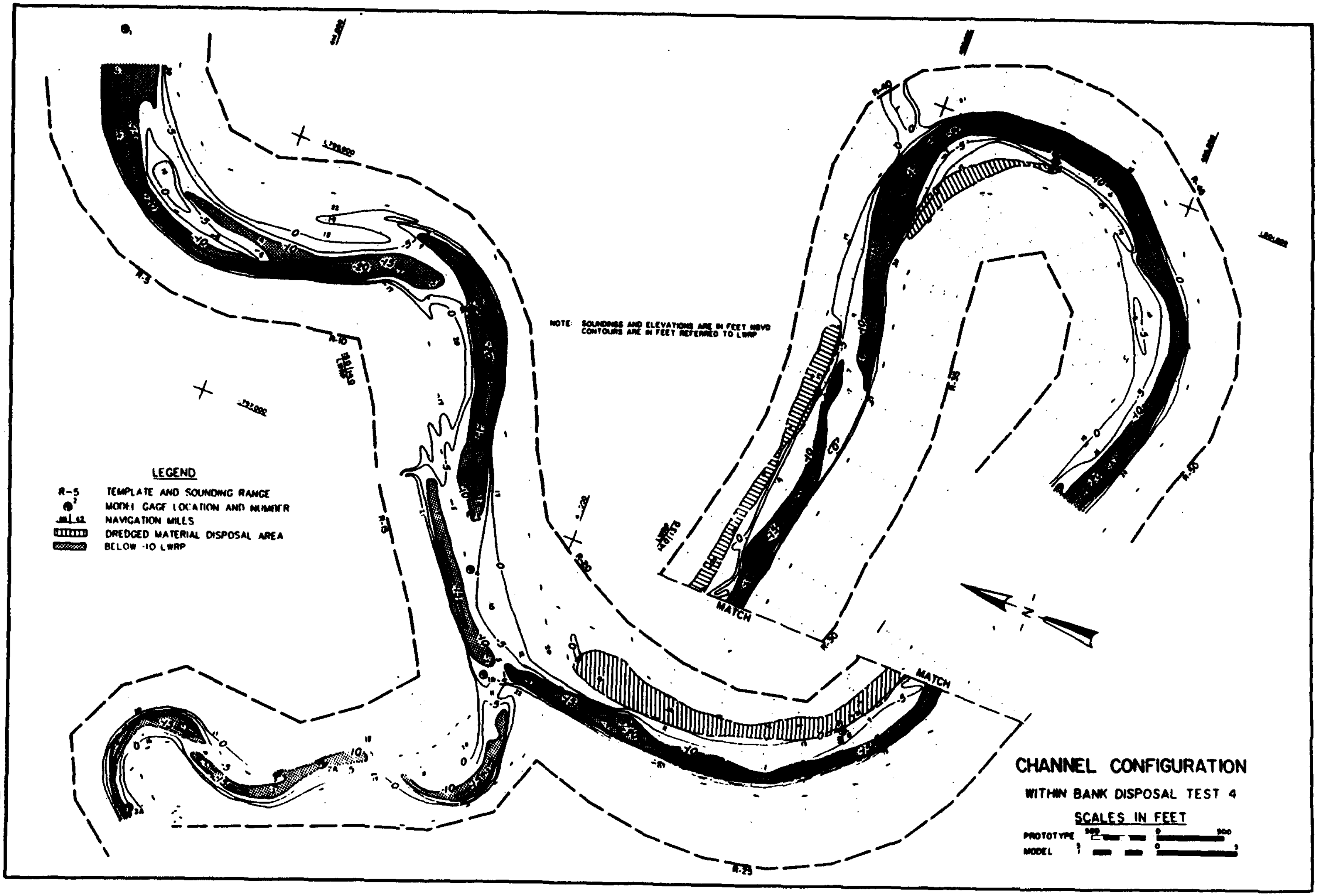
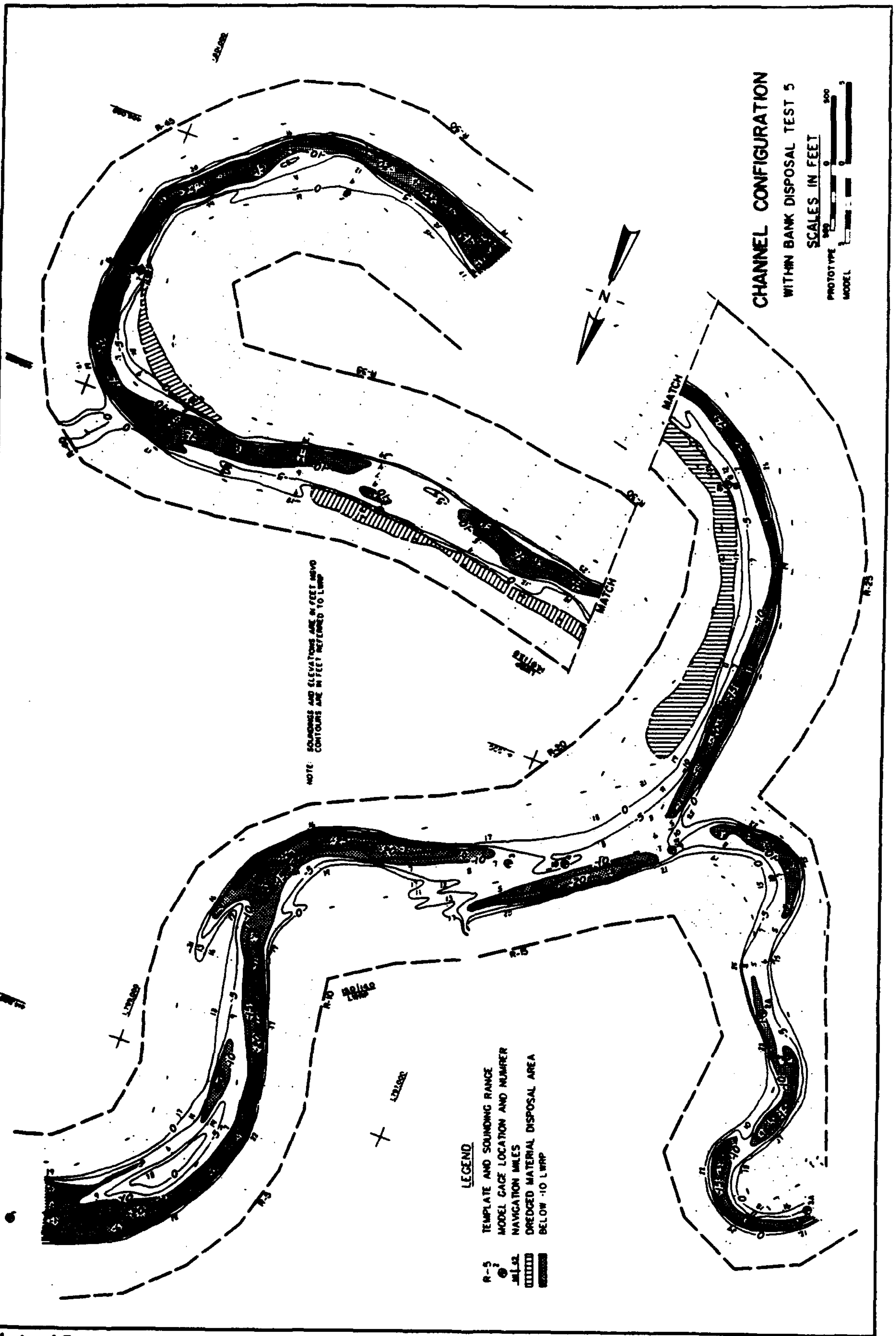

CHANNEL CONFIGURATION
WITHIN BANK DISPOSAL TEST 3
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
MATCH
MATCH
N
R-3
R-15
R-23
R-30

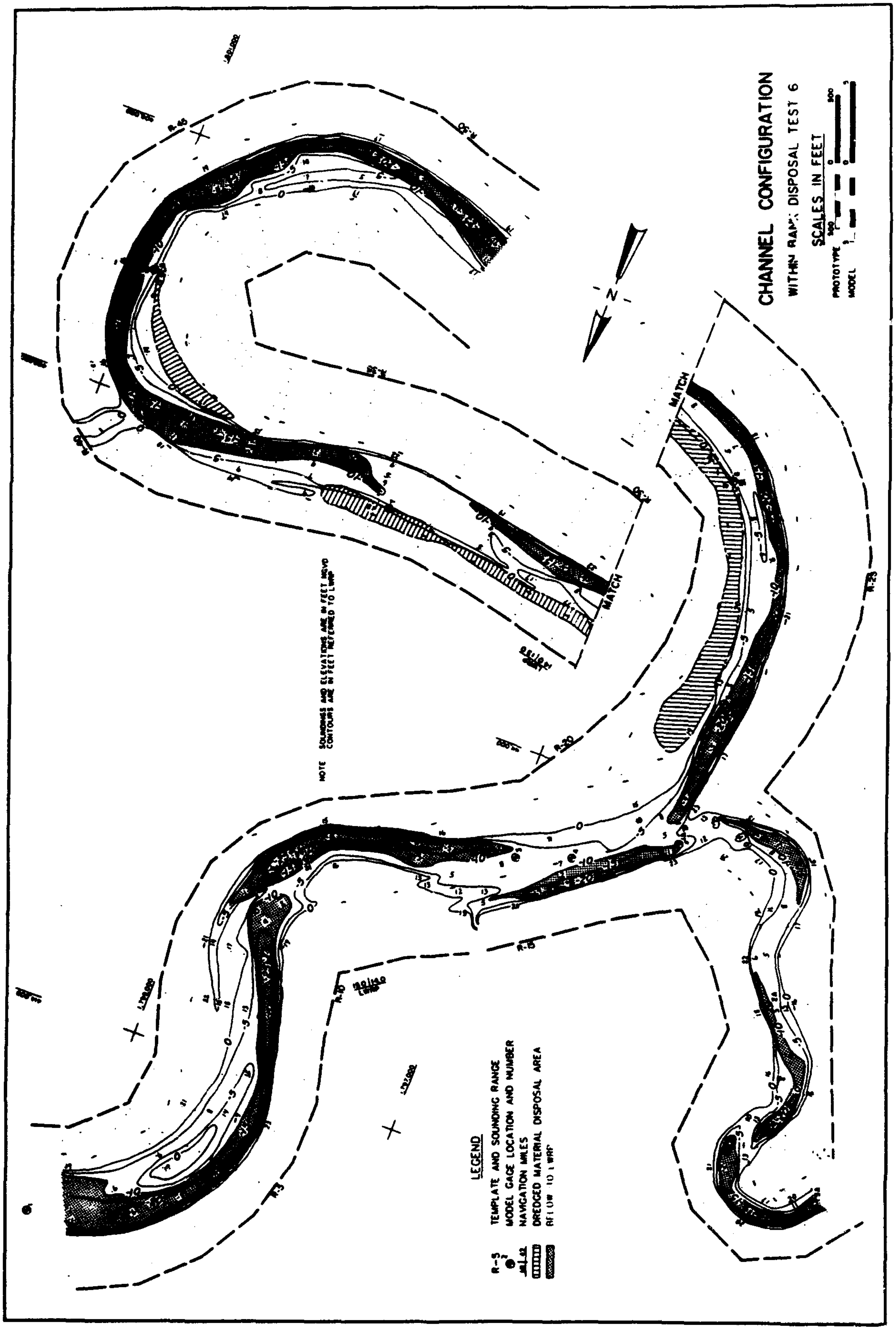
Plate 16


CHANNEL CONFIGURATION
WITHIN BANK DISPOSAL TEST 4
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH
N
R-3
R-10
R-15
R-20
R-25
R-30
R-35
R-50



CHANNEL CONFIGURATION
WITHIN BANK DISPOSAL TEST 5
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH
N

Plate 18



CHANNEL CONFIGURATION
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
DREDGED MATERIAL DISPOSAL AREA
NOTE SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH

Plate 19

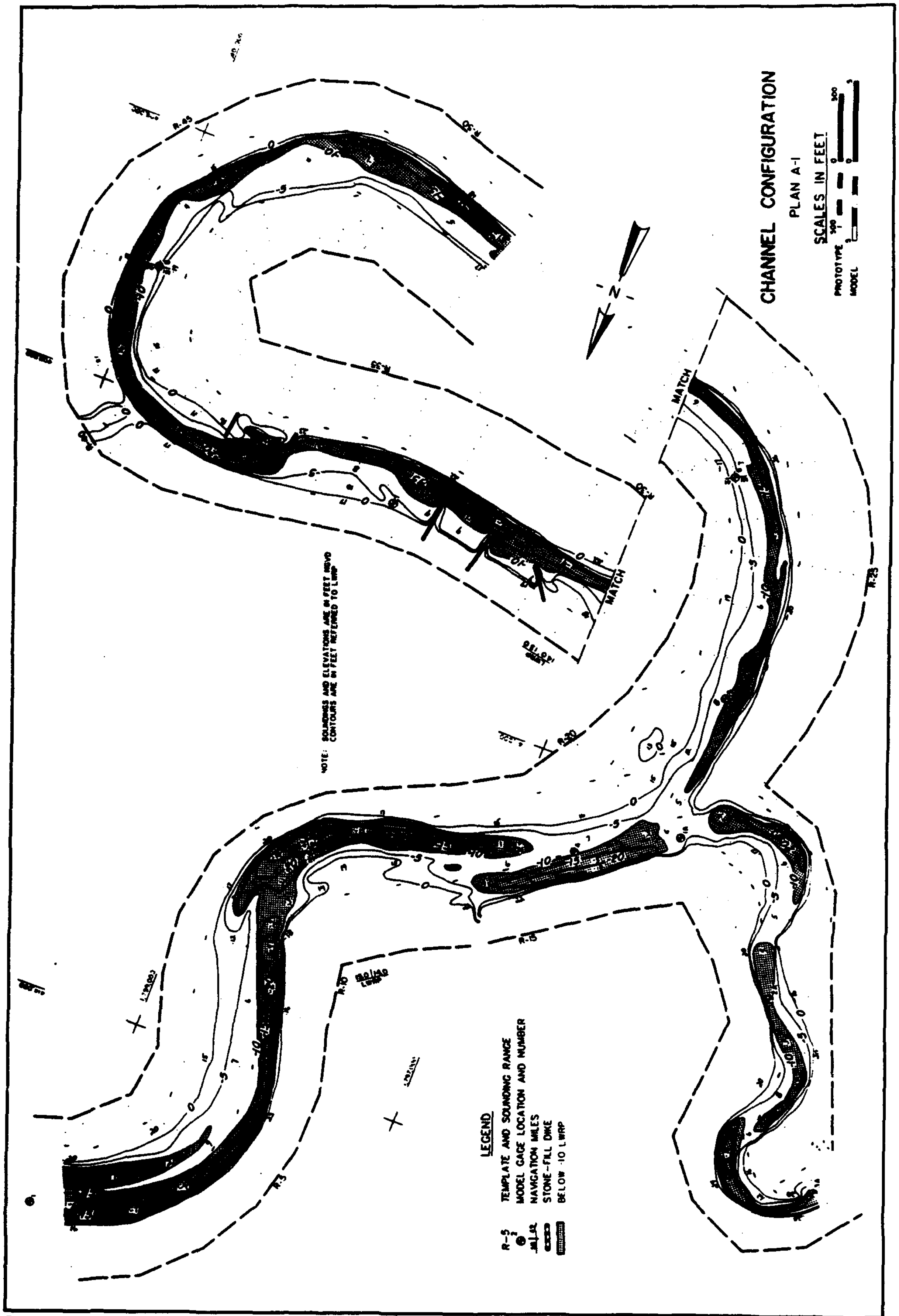
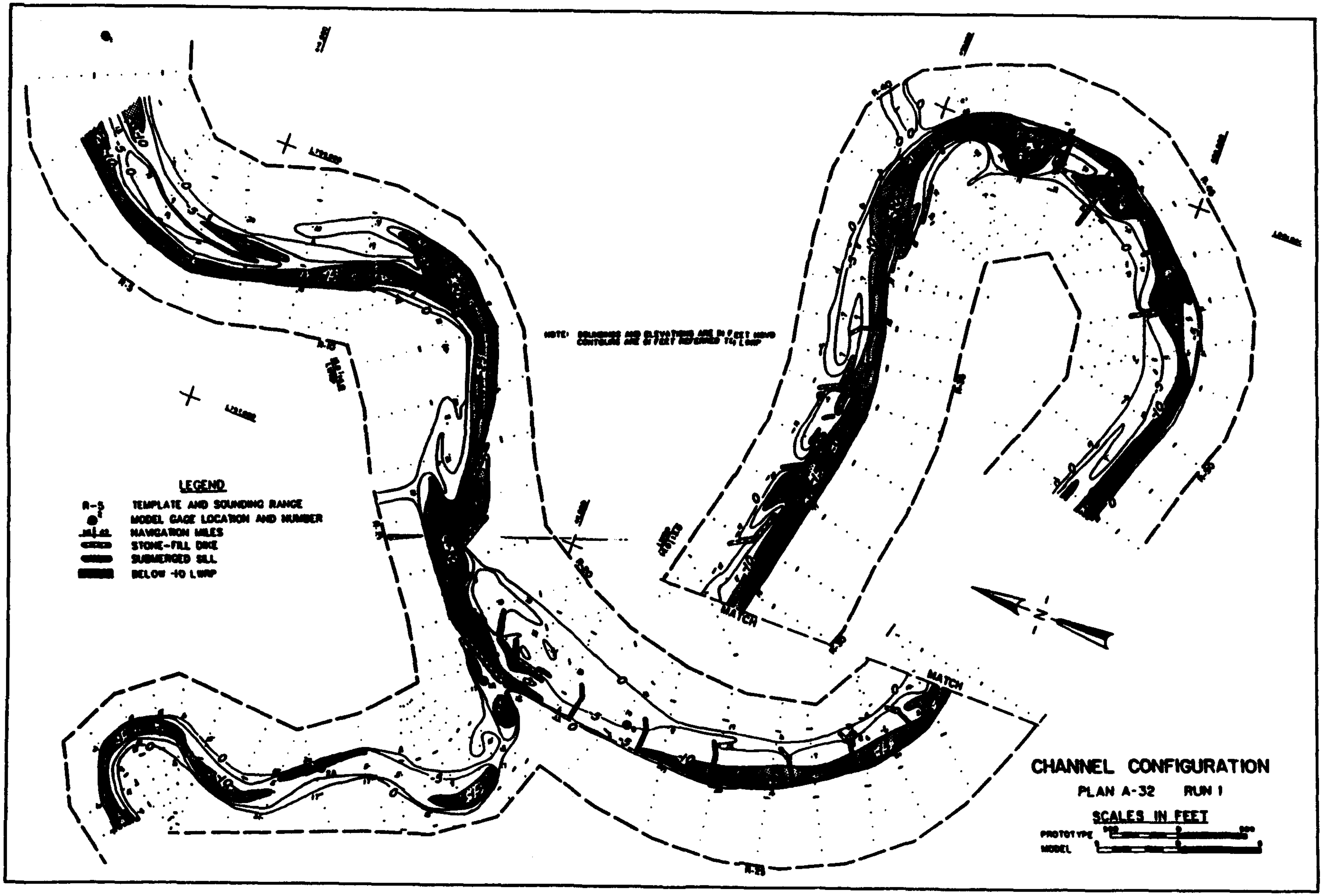
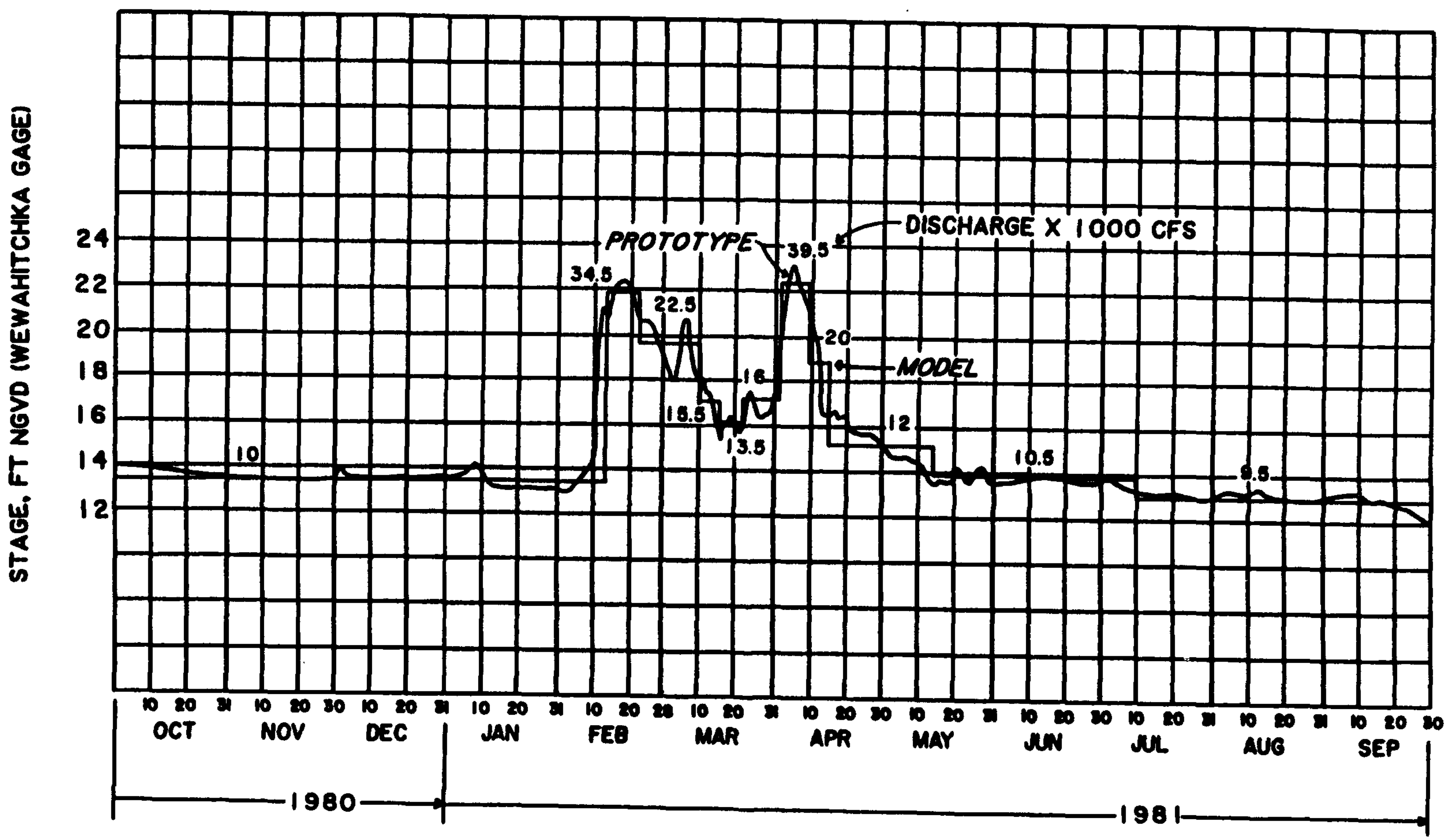

CHANNEL CONFIGURATION
PLAN A-1
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH
N

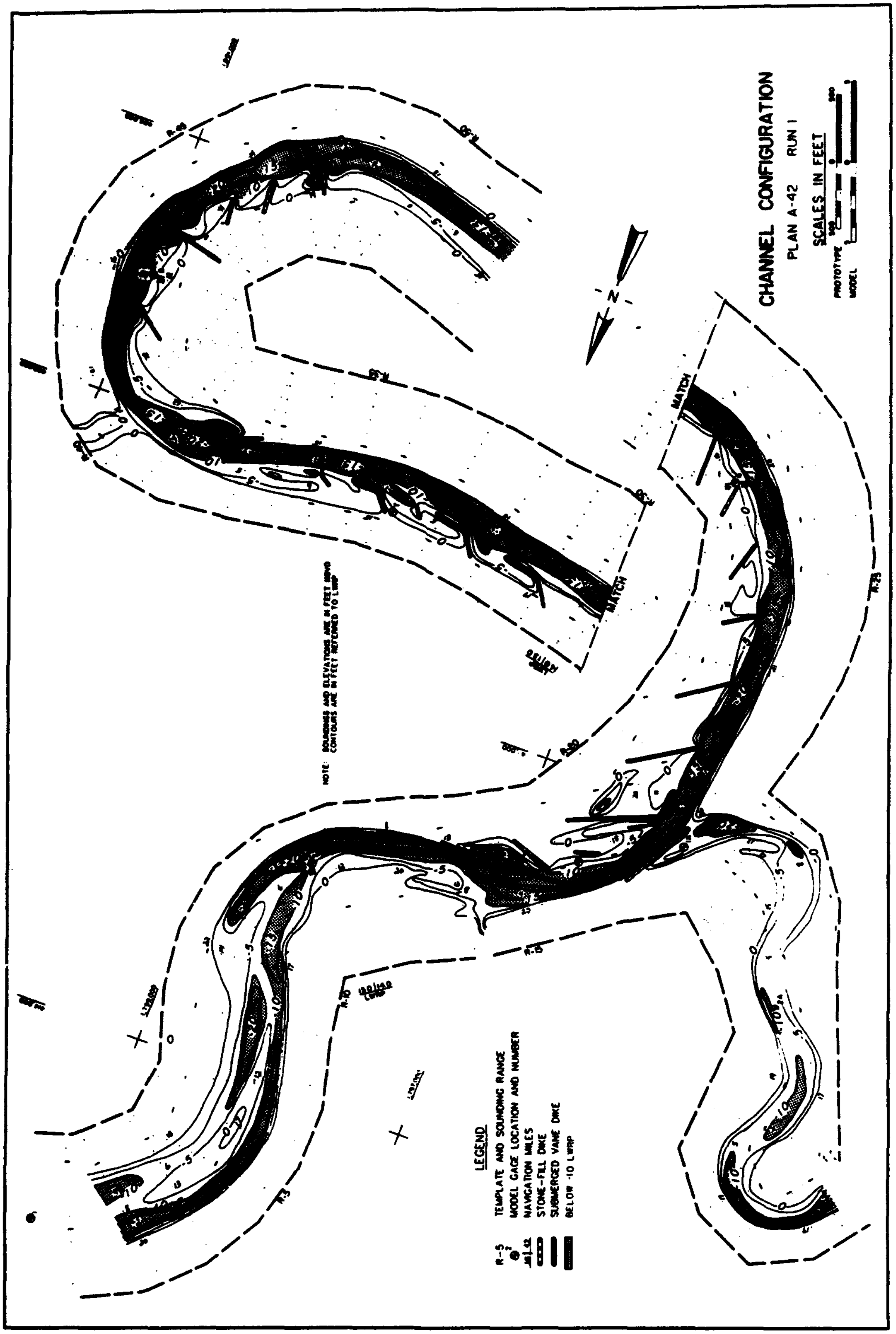
Plate 20

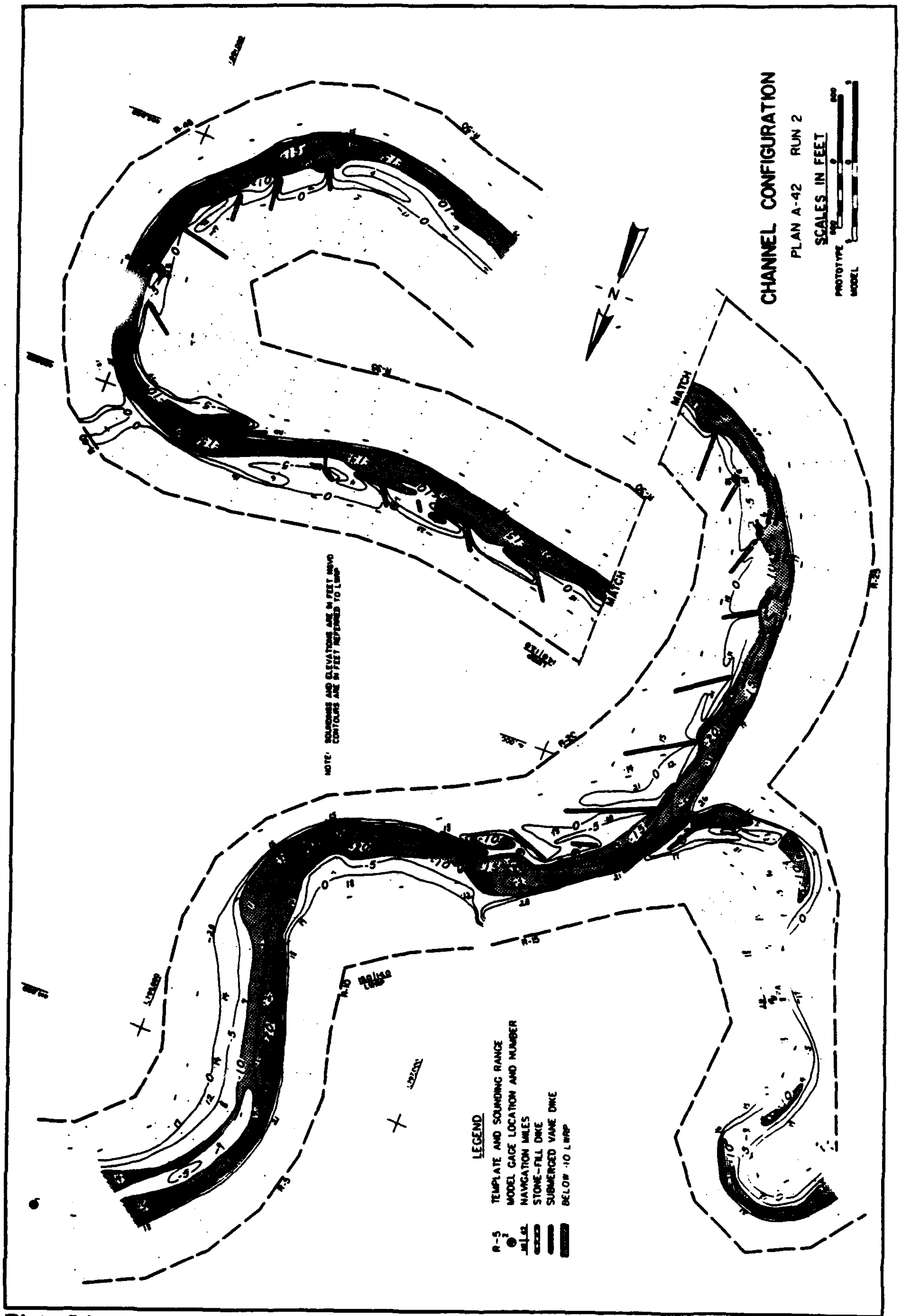

LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
SUBMERGED SILL
BELOW -10 LWRP
MATCH
MATCH
N
CHANNEL CONFIGURATION
PLAN A-32 RUN 1
SCALES IN FEET
PROTOTYPE
MODEL



LOW WATER HYDROGRAPH

Plate 22


CHANNEL CONFIGURATION
PLAN A-42 RUN 1
SCALES IN FEET
PROTOTYPE
MODEL
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
SUBMERGED VANE DIKE
BELOW -10 LWRP
MATCH
MATCH
N



CHANNEL CONFIGURATION
PLAN A-42 RUN 2
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
SUBMERGED VANE DIKE
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH

Plate 24

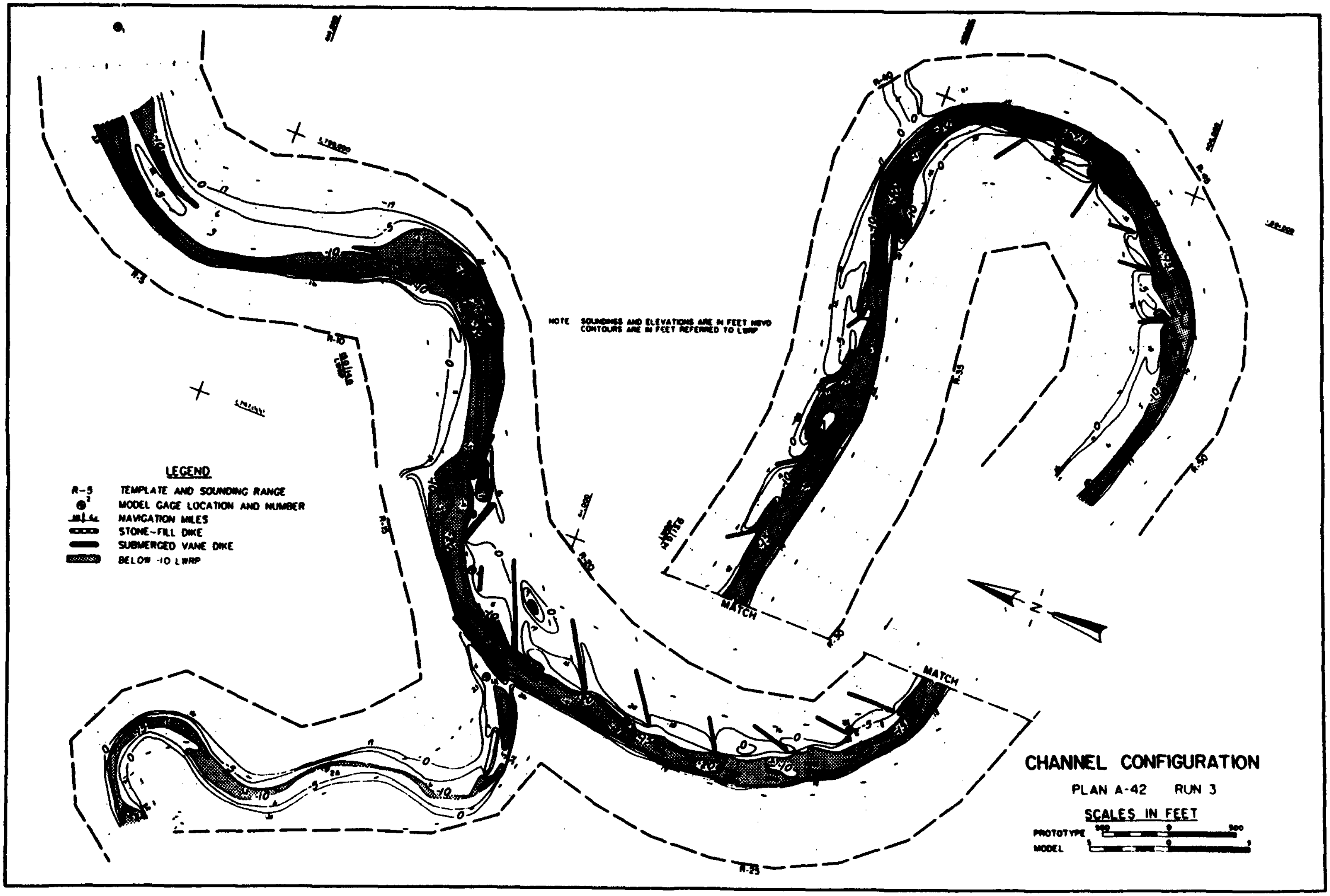
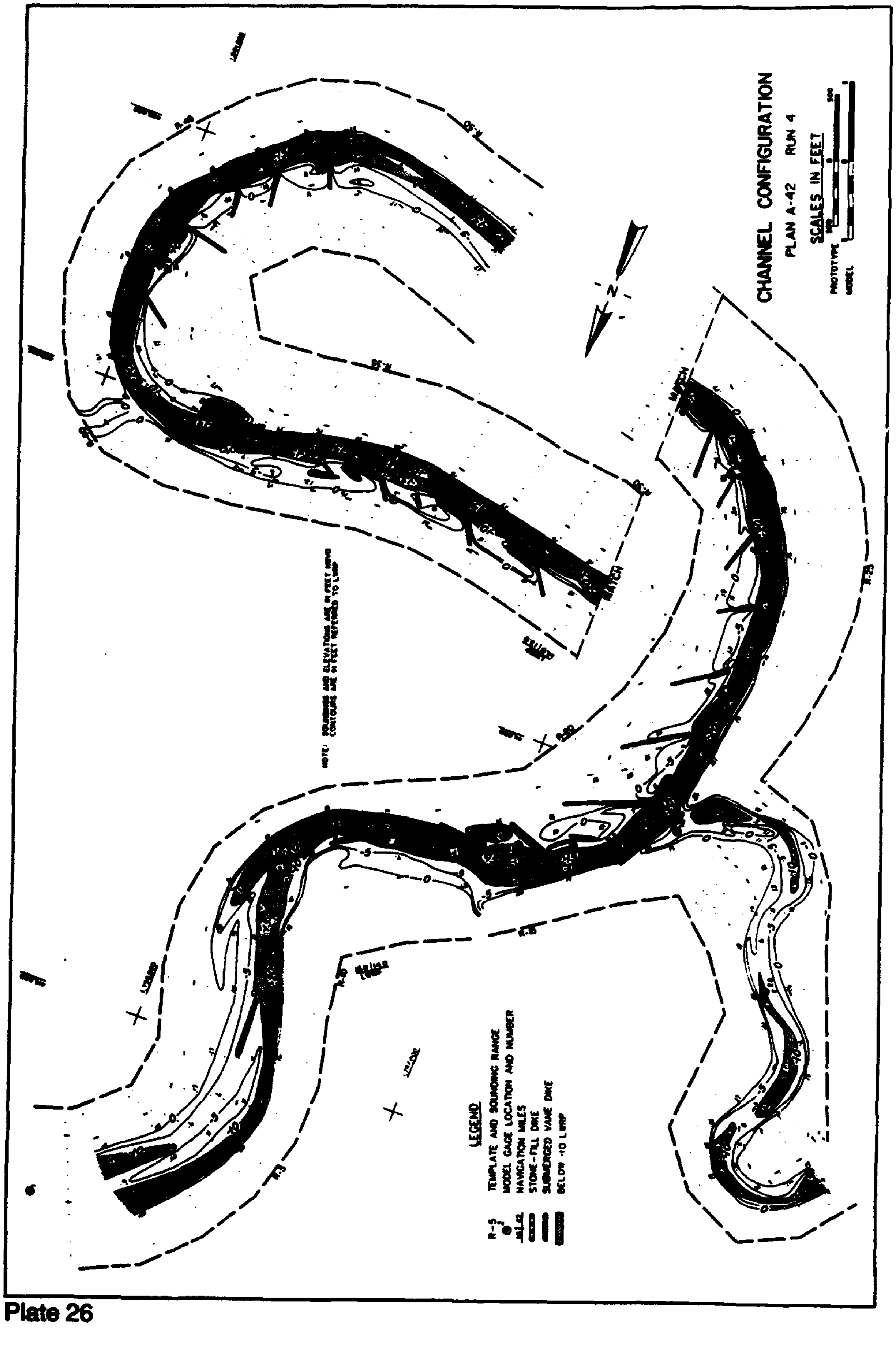
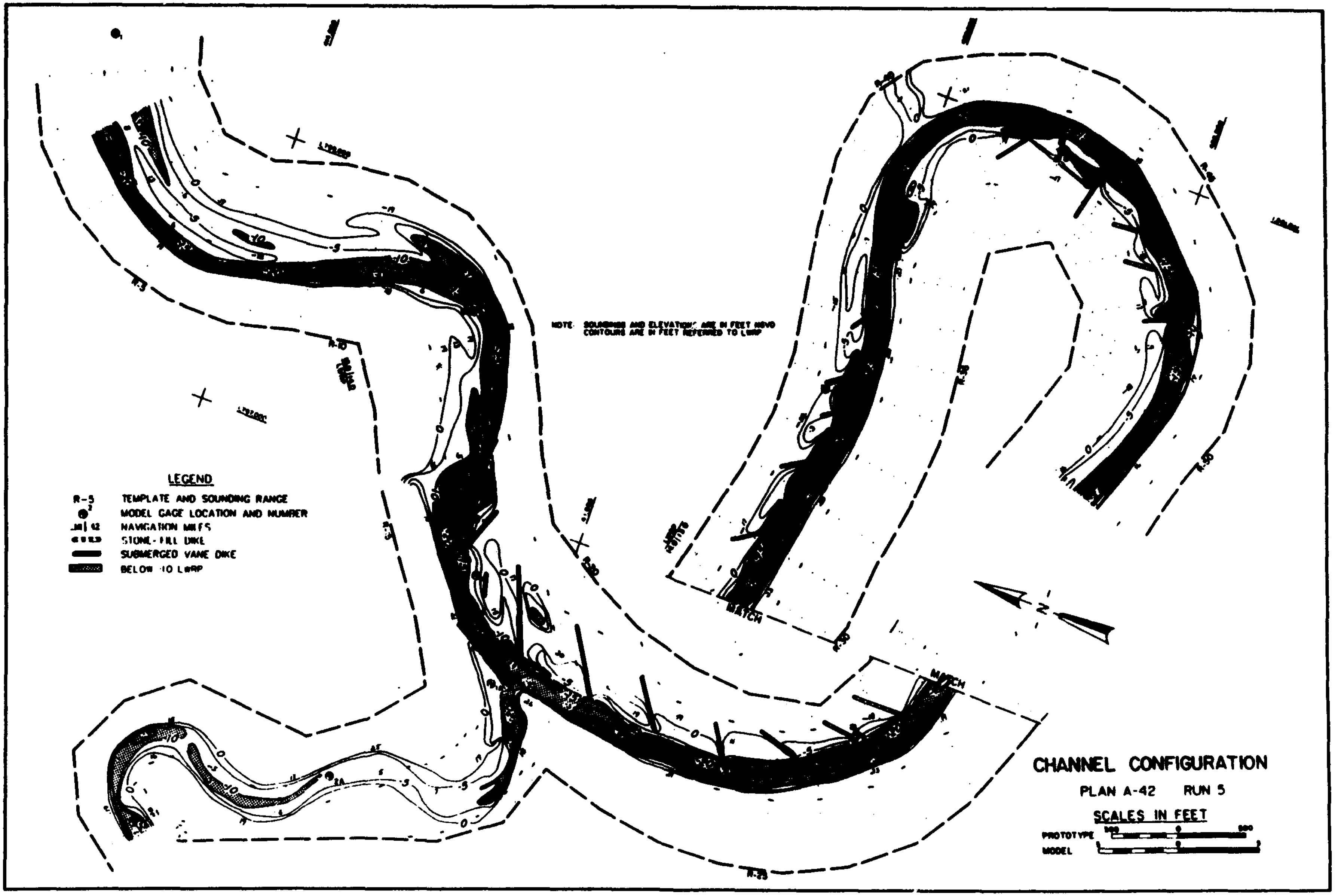

LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
SUBMERGED VANE DIKE
BELOW -10 LWRP
NOTE SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH
N
CHANNEL CONFIGURATION
PLAN A-42 RUN 3
SCALES IN FEET
PROTOTYPE
MODEL

Plate 25



CHANNEL CONFIGURATION
PLAN A-42 RUN 4
SCALES IN FEET
PROTOTYPE
MODEL
N
MATCH
MATCH
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD CONTOURS ARE IN FEET REFERRED TO LWRP
LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
SUBMERGED VANE DIKE
BELOW -10 LWRP

Plate 26


CHANNEL CONFIGURATION
PLAN A-42 RUN 5
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
R-5 TEMPLATE AND SOUNDING RANGE
MODEL GAGE LOCATION AND NUMBER
NAVIGATION MILES
STONE-FILL DIKE
SUBMERGED VANE DIKE
BELOW -10 LWRP
NOTE: SOUNDINGS AND ELEVATIONS ARE IN FEET NGVD
CONTOURS ARE IN FEET REFERRED TO LWRP
MATCH
MATCH
R-3
R-5
R-10
R-25
R-30

REPORT DOCUMENTATION PAGE

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Movable-Bed Model Study

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Randy A. McCollum

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12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Chipola Cutoff Reach, Apalachicola River, is located between navigation miles 42.7 and 39.5. This area requires approximately 100,000 cu yd of dredging annually to maintain the 100-ft by 9-ft authorized navigation channel.

The model study was conducted to examine the effects of depositing the dredged material on the point bars within the channel banks and in the thalweg of the bendways and to develop a system of contraction works to reduce or eliminate the maintenance dredging.

The model, built to a horizontal scale of 1:120 and a vertical scale of 1:80, was of the movable-bed type and allowed flow through the Apalachicola River and through the Chipola Cutoff.

Results of the study indicate the following:

a. Thalweg disposal of dredged material has little effect on dredging requirements and the placed material erodes slowly; therefore, the storage capacity is quickly depleted.
b. Within-bank disposal has little effect on dredging requirements; and due to slow erosion of the deposited material, storage capacity is quickly depleted.

(Continued)

14. SUBJECT TERMS
See reverse.

15. NUMBER OF PAGES
40

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		

13. (Concluded).

c. The system of conventional dikes of Plan A-32 will not provide an adequate channel.

d. The system of conventional dikes and submerged vane dikes of Plan A-42 will develop and maintain an adequate channel with minimal dredging required.

14. (Concluded).

Channel improvement	Sedimentation
Dikes (contraction works)	Submerged vane dikes
Dredged material disposal	Thalweg
Movable-bed models	